



AFRL-VA-WP-TM-2007-3095

EXERGY ANALYSIS FOR ENERGY SYSTEMS

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Gorla Consultants, Inc.

SEPTEMBER 2006

Final Report

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REPORT DOCUMENTATION PAGE					<i>Form Approved</i> OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YY) September 2006		2. REPORT TYPE Final		3. DATES COVERED (From - To) 15 May 2006 – 30 September 2006		
4. TITLE AND SUBTITLE EXERGY ANALYSIS FOR ENERGY SYSTEMS				5a. CONTRACT NUMBER IN-HOUSE		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER 0602201		
6. AUTHOR(S) Dr. Rama S.R. Gorla				5d. PROJECT NUMBER A03I		
				5e. TASK NUMBER N/A		
				5f. WORK UNIT NUMBER A03IOA		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Gorla Consultants, Inc. 8041 Oxford Drive Strongsville, OH 44149				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Air Vehicles Directorate Wright-Patterson Air Force Base, OH 45433-7542 Air Force Materiel Command United States Air Force				10. SPONSORING/MONITORING AGENCY ACRONYM(S) AFRL/VAS		
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER(S) AFRL-VA-WP-TM-2007-3095		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited. PAO case number AFRL/WS 07-1975, 27 August 2007.						
13. SUPPLEMENTARY NOTES Report contains color.						
14. ABSTRACT In Phase Change transport devices, capillary forces drive the overall circulation of working fluid from an evaporator to a condenser section. An analysis has been provided for the entropy generated for the combined heat and mass transfer in a circular tube and micro/nano scale heat and mass transfer in a capillary tube in terms of the gradients of velocity, temperature, and concentration as well as the physical properties of the fluid. The heat and mass transfer rates are assumed to be uniform on the surface of the tube. The optimum geometric configuration that corresponds to the minimization of entropy generated and minimization of fluid flow resistance is identified.						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT: SAR	18. NUMBER OF PAGES 202	19a. NAME OF RESPONSIBLE PERSON (Monitor) David Pratt 19b. TELEPHONE NUMBER (Include Area Code) (937) 255-5042	
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified				

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NOMENCLATURE

a	Tube radius or channel gap half-width
Be	Bejan Number
Br	Brinkman number
C	Fluid specific heat
Dh	Channel hydraulic diameter
G_C	G_axial
G_F	G_fluid friction
G_H	G_heat flux
G_R	G_radial
k	Thermal conductivity
N_S	Dimensionless entropy generation number
N_F	Entropy generation due to the fluid friction
N_C	Entropy generation due to heat transfer in the axial direction
N_Y	Entropy generation due to heat transfer in the transverse direction
N_R	Entropy generation due to heat transfer in the radial direction
N_H	Entropy generation due to heat transfer in the axial (or radial) and transverse direction
Pe	Peclet number
q''_w	Wall heat flux
r	Radial coordinate

R	Normalized radial coordinate, r/a
s_e	Volumetric Joule heating
S	Dimensionless joule heating parameter
S_v	Dimensionless viscous heating parameter
T	Absolute temperature
T_m	Mixed mean temperature
T_w	Channel wall temperature
u	Local fluid velocity
u_{\max}	Maximum possible electro-osmotic velocity
\bar{u}	Average velocity
U	Normalized local velocity, u / \bar{u}
w	Parallel plate channel width
x	Streamwise coordinate
y	Wall-normal coordinate
Y	Normalized wall-normal coordinate, y/a
Z	Relative duct radius, a/λ

Greek symbols

α	Thermal diffusivity
ε	Fluid dielectric constant
ϕ	Applied potential field

Φ	Irreversibility ratio
λ	Debye length
μ	Fluid dynamic viscosity
θ	Normalized temperature
θ_w	Normalized wall temperature
ρ	Fluid density
ψ	Wall zeta potential

ENTROPY GENERATION IN THERMALLY FULLY DEVELOPED ELECTRO-OSMOTIC HEAT TRANSFER IN MICROCHANNELS

ABSTRACT

An analysis has been provided for the entropy generation in thermally fully developed electro-osmotically generated flow in a parallel plate microchannel and a circular microtube in terms of Brinkman number, Peclet number, relative duct radius, dimensionless joule heating parameter, dimensionless viscous heating parameter as well as physical properties of the fluid under imposed constant wall heat flux boundary condition. Such a flow is established not by an imposed pressure gradient, but by a voltage potential gradient along the length of the tube. The momentum and energy equations are solved to get the velocity and temperature distributions and the exact solution for the dimensionless entropy generation number have been determined analytically for both geometries. This analysis assumes no pressure-driven component to the velocity field and constant fluid properties. Five different variables namely, (i) dimensionless joule heating parameter, (ii) dimensionless viscous heating parameter, (iii) relative duct radius, (iv) Peclet number and (v) Brinkman number have been identified from the dimensionless entropy generation number equation. Various plots for dimensionless entropy generation number, Bejan number, Irreversibility ratio, entropy generation due to fluid friction etc. are generated using MATLAB and analyzed for both the configurations.

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Microfluidic transport has found importance in a number of emerging technologies in micropower generation, chemical separation processes, cell analysis and other biomedical diagnostic techniques. At physical scales of order 100 μm , generating fluid motion in the tube poses a considerable challenge. Conventional pressure-driven flow technology requires significant pressures, and while micropumps exist which are capable of delivering such pressures [1], they are difficult to manufacture and maintain, and lack the precise control that is often needed in microfluidic applications [2]. Electro-osmotic flow may provide a viable alternative to pressure-driven liquid flow at the microscale with better flow control and no moving parts. Several investigators have reported on electro-osmotic pump systems [3-4].

Electro-osmosis is the bulk movement of liquid relative to a stationary surface due to an externally applied electric field, and was first observed and reported by Reuss [5] nearly two centuries ago. Most solid substances will acquire a relative electric charge when in contact with an aqueous electrolytic solution, which in turn influences the charge distribution in the solution. Ions of opposite charge (counterions) to that of the surface are attracted towards the surface and ions of the same charge (coions) are repelled from the surface as shown in Fig 1a [6].

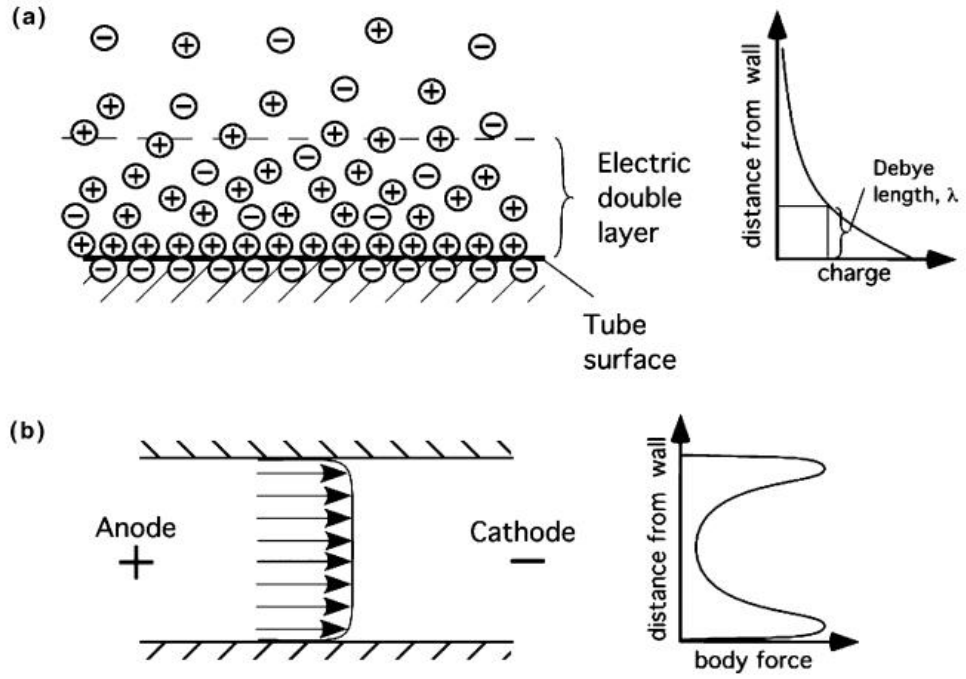


Figure 1a, b Schematic illustration of electro-osmotically generated flow

The net effect is the formation of a region close to the charged surface called the electric double layer [EDL] in which there is an excess of counter ions over coions, and which are distributed in a diffuse manner [7]. The charge distribution in the fluid therefore falls from its maximum near the wall to a zero charge in the fluid core. The thickness of the EDL is characterized by the Debye length, which is the wall-normal distance over which the net charge has decreased from the charge magnitude near the tube surface to $1/e$ (37%) of the surface charge. The positively charged cations and solvent molecules strongly adsorbed at the wall remain stationary under the influence of an electric potential in the streamwise direction, while the mobile cations in the EDL very near the tube walls will migrate toward the cathode due to the excess charge in the layer. This gives rise to a concentrated fluid body force near the channel or tube walls as

illustrated in Fig 1b. Viscous shear forces transmitted from the EDL to the channel or tube center pull the core fluid towards the cathode as well. The resulting electro-osmotic flow velocity distribution is a function of the ratio of the hydraulic radius to the Debye length.

The fluid dynamics of electro-osmotically generated flow are significantly different from traditional pressure-driven flow, and therefore, the thermal transport dynamics are expected to be quite different as well. The applied driving voltage gradient and its induced electric conduction current establish Joule heating in the fluid, resulting in volumetric energy generation therein [6]. The magnitude of the thermal energy source has significant influence on the temperature distribution and heat transfer.

Several analytical studies have appeared in the literature describing the hydrodynamics of fully-developed electro-osmotic flow through circular tubes and rectangular channels. Specifically, several early papers report on electro-osmotic velocity distributions and the associated momentum transport in capillaries as a function of channel diameter-to-Debye length ratio [8, 9]. More recent hydrodynamic studies have explored the effects on the velocity field due to streamwise gradients in the electrical conductivity [10], the transient response of the velocity field to a suddenly applied voltage gradient [11] and the entry region flow field development [12]. Additionally, some experimental studies have reported on the velocity profile characteristics associated with fully-developed electro-osmotic flow in very long circular tubes and rectangular channels [13, 14].

With regard to characterization of the convection heat transfer associated with electro-osmotic flow, relatively little prior work has appeared in the literature. Li and

coworkers [15] have explored electrokinetic effects induced in a pressure-driven flow on the frictional and heat transfer characteristics for both round and rectangular microchannels. There also exists some early work exploring the effect of volumetric energy generation on thermal development in channels under pressure-driven flow conditions [16]. Knox [17] has explored the influence of Joule heating on efficiency in capillary electrophoresis. The fully-developed thermal transport for constant-property electro-osmotic flow in circular microtubes and parallel plate microchannels was previously explored for the case of negligible viscous heating [18]. Additionally, thermally fully-developed heat transfer has been explored for combined electro-osmotic and pressure driven, constant-property flow in a circular microtube under imposed constant wall heat flux boundary condition [19].

No studies have appeared in the literature that specifically address the entropy generation for purely electro-osmotically driven flow for both the configurations, parallel plate microchannel and circular microtube. The present work has been undertaken in order to study the entropy generation for fully-developed electro-osmotic flow in parallel plate microchannel and circular microtube for constant wall heat flux boundary condition. The results are then analyzed for both the configurations and conclusions are derived. This analysis assumes no pressure-driven component to the velocity field and constant fluid properties.

CHAPTER II

MATHEMATICAL FORMULATION AND ANALYSIS FOR PARALLEL PLATE MICROCHANNEL

Consider a fully developed electro-osmotically driven flow of an incompressible fluid in a parallel plate microchannel of infinite width with coordinates as defined in Figure 2a.

Momentum transport:

For steady flow without an applied pressure gradient the streamwise momentum equation reduces [18] to

$$\mu \frac{1}{y^n} \frac{d}{dy} \left(y^n \frac{du}{dy} \right) + \frac{\varepsilon}{y^n} \frac{d}{dy} \left(y^n \frac{d\psi}{dy} \right) \frac{d\phi}{dx} = 0 \quad (1)$$

Where, $n = 0$. μ is the fluid viscosity, ε is the dielectric constant, ϕ is the applied potential field and $\psi(y)$ is the access charge distribution.

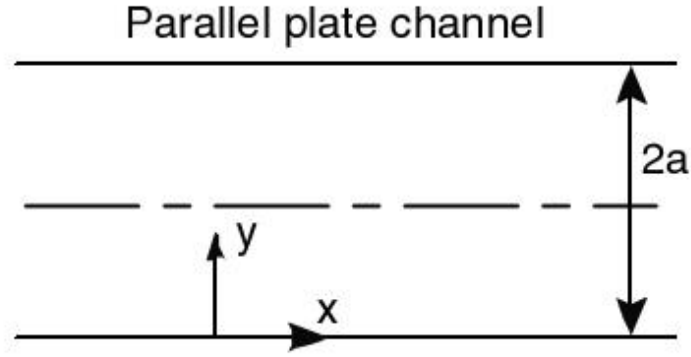


Figure 2a Definition of coordinate system for Parallel plate microchannel

For low wall potential, the Debye–Huckel linearization is valid [7], and the excess charge distribution may be expressed explicitly as a function only of the zeta potential, the Debye length λ and the wall-normal coordinate y . For such a scenario, the momentum equation (1) may be solved subject to boundary conditions reflecting no slip at the wall and zero shear stress at the centerline, the fully-developed electro-osmotic velocity distribution for the parallel plate can be expressed as [2,7]

$$\frac{u}{u_{\max}} = 1 - Y \cdot Z \cdot e^{-Z} - e^{-Y \cdot Z} \quad (Y \leq 1) \quad (2)$$

where, $Y = y/a$ is the normalized wall-normal coordinate and $Z = a/\lambda$ is the relative duct radius. The Debye length λ is a function of the electro-chemical characteristics of the liquid / tube interface, and rather difficult to measure. It may be estimated from the relation $\lambda = (\epsilon RT / 2F^2 z^2 c)^{1/2}$ where ϵ , T , R and F are the fluid permittivity, absolute temperature, universal gas constant, and Faraday's constant respectively. The parameters z and c are the valence number and the average molar concentration of ions in the liquid solution.

Taking partial derivative of equation (2) with respect to Y ,

$$\frac{\partial \bar{u}}{\partial Y} = Z \cdot e^{-Y \cdot Z} - Z \cdot e^{-Z} \quad \text{where } \bar{u} = \frac{u}{u_{\max}}$$

We can also write $\frac{\partial u}{\partial y}$ as,

$$\frac{\partial u}{\partial y} = \frac{\frac{\partial}{\partial \frac{y}{a}} \cdot u_{\max}}{\frac{\partial \frac{y}{a}}{\partial y}}$$

$$\frac{\partial u}{\partial y} = \frac{u_{\max}}{a} \left(\frac{\partial \bar{u}}{\partial Y} \right)$$

$$\left(\frac{\partial u}{\partial y} \right)^2 = \frac{u_{\max}^2}{a^2} \left(Z^2 \cdot e^{-2Y \cdot Z} - 2 \cdot Z^2 \cdot e^{-Z-Y \cdot Z} + Z^2 \cdot e^{-2Z} \right) \quad (3)$$

Energy equation:

Given steady hydrodynamically fully developed flow with constant thermophysical properties, the energy equation simplifies [18] to

$$\frac{\partial^2 T}{\partial x^2} + \frac{1}{y^n} \frac{\partial}{\partial y} \left(y^n \frac{\partial T}{\partial y} \right) = \frac{u}{\alpha} \frac{\partial T}{\partial x} - \frac{s}{k} \quad (4)$$

where, $n = 0$ for the channel flow. T is the local temperature, α is the thermal diffusivity, k is the thermal conductivity and s is the volumetric Joule heating.

With an imposed constant heat flux boundary condition ($q_w'' = \text{constant}$),

$$\frac{\partial T}{\partial x} = \frac{dT_m}{dx} = \text{constant}$$

Furthermore, an energy balance on the fluid yields

$$\frac{\partial T}{\partial x} = \frac{4 \cdot q_w''}{\rho \cdot \bar{u} \cdot C \cdot D_h} + \frac{s}{\rho \cdot \bar{u} \cdot C} \quad (5)$$

In the above equation, Dh is the channel hydraulic diameter, q_w'' is the wall heat flux and C is the fluid specific heat.

Performing square of equation (5),

$$\left(\frac{\partial T}{\partial x}\right)^2 = \left(\frac{16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h}{\rho^2 \cdot \bar{u}^2 \cdot C^2 \cdot D_h^2}\right) \quad (6)$$

Now, the general expression for the temperature distribution for parallel plate microchannel [6] is,

$$\theta = \{1 + S \cdot [1 + S_v \cdot F(Z)]\} \cdot A_2(Y, Z) + S \cdot [A_1(Y) - S_v \cdot A_3(Y, Z)] \quad (7)$$

where, S = dimensionless joule heating parameter, S_v = dimensionless viscous heating

parameter and $\theta = \frac{k \cdot T}{a \cdot q_w''}$ = normalized temperature. Also,

$$F(Z) = \frac{3 \cdot e^{-2Z}}{2 \cdot Z} - \frac{2 \cdot e^{-2Z}}{Z} + e^{-2Z} + \frac{1}{2 \cdot Z} \quad (8)$$

$$A_1(Y) = -\left(\frac{Y^2}{2} - Y\right) \quad (9)$$

$$A_2(Y, Z) = \frac{1}{Z^2} (1 - e^{-Y \cdot Z}) - Y \left(1 + \frac{e^{-Z}}{Z} - \frac{Z \cdot e^{-Z}}{2}\right) + \frac{Y^2}{2} - \frac{Y^3}{6} Z \cdot e^{-Z} \quad (10)$$

and

$$A_3(Y, Z) = \frac{1}{Z^2} \left[\frac{1}{4} (e^{-2Y \cdot Z} - 1) + 2(e^{-Z} - e^{-Z(Y+1)}) \right] - Y \left(e^{-2Z} + \frac{3 \cdot e^{-2Z}}{2 \cdot Z} \right) \quad (11)$$

Substituting the values of equations (8), (9), (10) and (11) into equation (7), we have

$$\begin{aligned}
\theta = & \left\{ 1 + S \cdot \left[1 + S_v \cdot \left(\frac{3 \cdot e^{-2Z}}{2 \cdot Z} - \frac{2 \cdot e^{-2Z}}{Z} + e^{-2Z} + \frac{1}{2 \cdot Z} \right) \right] \right\} \cdot \\
& \left(\frac{1}{Z^2} (1 - e^{-Y \cdot Z}) - Y \left(1 + \frac{e^{-Z}}{Z} - \frac{Z \cdot e^{-Z}}{2} \right) + \frac{Y^2}{2} - \frac{Y^3}{6} Z \cdot e^{-Z} \right) + \\
& S \cdot \left[\left(- \left(\frac{Y^2}{2} - Y \right) \right) - S_v \cdot \left(\frac{1}{Z^2} \left[\frac{1}{4} (e^{-2Y \cdot Z} - 1) + 2(e^{-Z} - e^{-Z(Y+1)}) \right] - Y \left(e^{-2Z} + \frac{3 \cdot e^{-2Z}}{2 \cdot Z} \right) \right) \right]
\end{aligned} \tag{12}$$

Taking partial derivative of equation (12) with respect to Y ,

$$\frac{\partial \theta}{\partial Y} = Term1 \tag{13}$$

Where

$$\begin{aligned}
Term1 = & \left(\frac{e^{-Y \cdot Z}}{Z} - 1 - \frac{e^{-Z}}{Z} + \frac{Z \cdot e^{-Z}}{2} + Y - \frac{Z \cdot Y^2 \cdot e^{-Z}}{2} \right) + \\
& \left(\frac{S \cdot e^{-Y \cdot Z}}{Z} - S - \frac{S \cdot e^{-Z}}{Z} + \frac{S \cdot Z \cdot e^{-Z}}{2} + S \cdot Y - \frac{S \cdot Y^2 \cdot Z \cdot e^{-Z}}{2} \right) + \\
& \left(\frac{3 \cdot S \cdot S_v \cdot e^{-2Z - Y \cdot Z}}{2 \cdot Z^2} - \frac{3 \cdot S \cdot S_v \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_v \cdot e^{-3Z}}{2 \cdot Z^2} - \frac{3 \cdot S \cdot S_v \cdot e^{-3Z}}{4} + \frac{3 \cdot S \cdot S_v \cdot Y \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_v \cdot Y^2 \cdot e^{-3Z}}{4} \right) - \\
& \left(\frac{-2 \cdot S \cdot S_v \cdot e^{-Z - Y \cdot Z}}{Z^2} + \frac{2 \cdot S \cdot S_v \cdot e^{-Z}}{Z} + \frac{2 \cdot S \cdot S_v \cdot e^{-2Z}}{Z^2} - \frac{S \cdot S_v \cdot e^{-2Z}}{1} - \frac{2 \cdot S \cdot S_v \cdot Y \cdot e^{-Z}}{Z} + \frac{S \cdot S_v \cdot Y^2 \cdot e^{-2Z}}{1} \right) + \\
& \left(\frac{S \cdot S_v \cdot e^{-Z - Y \cdot Z}}{Z} - \frac{S \cdot S_v \cdot e^{-Z}}{1} - \frac{S \cdot S_v \cdot e^{-2Z}}{Z} + \frac{S \cdot S_v \cdot Z \cdot e^{-2Z}}{2} + \frac{S \cdot S_v \cdot Y \cdot e^{-Z}}{1} - \frac{S \cdot S_v \cdot Y^2 \cdot e^{-2Z}}{2} \right) + \\
& \left(\frac{S \cdot S_v \cdot e^{-Y \cdot Z}}{2 \cdot Z^2} - \frac{S \cdot S_v}{2 \cdot Z} - \frac{S \cdot S_v \cdot e^{-Z}}{2 \cdot Z^2} + \frac{S \cdot S_v \cdot Z \cdot e^{-Z}}{4 \cdot Z} + \frac{S \cdot S_v \cdot Y}{2 \cdot Z} - \frac{S \cdot S_v \cdot Y^2 \cdot e^{-Z}}{4} \right) + \\
& \left(S - S \cdot Y - \frac{S \cdot S_v \cdot e^{-2Y \cdot Z}}{2 \cdot Z} - \frac{2 \cdot S \cdot S_v \cdot e^{-Z - Y \cdot Z}}{Z} + \frac{S \cdot S_v \cdot e^{-2Z}}{1} - \frac{3 \cdot S \cdot S_v \cdot e^{-2Z}}{2 \cdot Z} \right)
\end{aligned}$$

Performing square of equation (13) using Mathematica,

$$\left(\frac{\partial \theta}{\partial Y} \right)^2 = [Term1]^2 \tag{14}$$

Also, we know,

$$\theta = \frac{k \cdot T}{a \cdot q_w''} \quad (15)$$

$$\left(\frac{\partial T}{\partial Y}\right)^2 = \left(\frac{a \cdot q_w''}{k}\right)^2 \cdot \left(\frac{\partial \theta}{\partial Y}\right)^2 \quad (16)$$

Substituting value of equation (14) into equation (16),

$$\left(\frac{\partial T}{\partial Y}\right)^2 = \left(\frac{a \cdot q_w''}{k}\right)^2 \cdot [Term1]^2 \quad (17)$$

We can also write $\frac{\partial T}{\partial Y}$ as,

$$\frac{\partial T}{\partial Y} = \frac{\partial T}{\partial Y \cdot a \cdot \frac{1}{a}}$$

$$\left(\frac{\partial T}{\partial Y}\right)^2 = a^2 \left(\frac{\partial T}{\partial y}\right)^2 \quad (18)$$

Comparing equations (17) and (18),

$$\left(\frac{\partial T}{\partial y}\right)^2 = \left(\frac{q_w''}{k}\right)^2 \cdot [Term1]^2 \quad (19)$$

Flow and heat transfer processes inside the plate are irreversible. The non-equilibrium conditions arise due to the exchange of energy, mass and momentum within the fluid and at solid boundaries, thus resulting in entropy generation. A part of the entropy production is due to the heat transfer in the direction of finite temperature and the other part of entropy production arises due to the fluid friction.

The equation for the entropy generation per unit volume is given by

$$S_G''' = \frac{\mu}{T_0} \left(\frac{\partial u}{\partial y} \right)^2 + \frac{k}{T_0^2} \left[\left(\frac{\partial T}{\partial x} \right)^2 + \left(\frac{\partial T}{\partial y} \right)^2 \right] \quad (20)$$

In the above equation,

$$\frac{\mu}{T_0} \left(\frac{\partial u}{\partial y} \right)^2 = \text{friction Component} \quad \text{and}$$

$$\frac{k}{T_0^2} \left[\left(\frac{\partial T}{\partial x} \right)^2 + \left(\frac{\partial T}{\partial y} \right)^2 \right] = \text{heat flux component}$$

here, $\frac{k}{T_0^2} \left(\frac{\partial T}{\partial x} \right)^2 = \text{axial heat flux component}$ and $\frac{k}{T_0^2} \left(\frac{\partial T}{\partial y} \right)^2 = \text{transverse heat flux component}$

Multiplying both sides by $k \cdot T_0^2 / q_w''^2$ to get the value of N_S ,

$$\left(\frac{k \cdot T_0^2}{q_w''^2} \right) S_G''' = N_S = \frac{\mu \cdot k \cdot T_0}{q_w''^2} \left(\frac{\partial u}{\partial y} \right)^2 + \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial x} \right)^2 + \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial y} \right)^2 \quad (21)$$

$$N_S = N_F + N_C + N_Y \quad (22)$$

In the above equations,

N_S = dimensionless entropy generation number

$$N_F = \frac{\mu \cdot k \cdot T_0}{q_w''^2} \left(\frac{\partial u}{\partial y} \right)^2 = \text{entropy generation due to the fluid friction}$$

$$N_C = \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial x} \right)^2 = \text{entropy generation due to heat transfer in the axial direction}$$

$$N_Y = \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial y} \right)^2 = \text{entropy generation due to heat transfer in the transverse direction}$$

Substituting values from equations (3), (6) and (19) into equation (21),

$$\begin{aligned}
N_s &= \frac{\mu \cdot k \cdot T_0}{q_w''^2} \left[\frac{u_{\max}^2}{a^2} (Z^2 \cdot e^{-2Y \cdot Z} - 2 \cdot Z^2 \cdot e^{-Z-Y \cdot Z} + Z^2 \cdot e^{-2Z}) \right] + \\
&\quad \frac{k^2}{q_w''^2} \left[\left(\frac{16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h}{\rho^2 \cdot \bar{u}^2 \cdot C^2 \cdot D_h^2} \right) \right] + \frac{k^2}{q_w''^2} \left[\left(\frac{q_w''}{k} \right)^2 \cdot [Term1]^2 \right] \\
N_s &= \frac{u_{\max}^2 \cdot \mu \cdot k \cdot T_0}{q_w''^2 \cdot a^2} [Z^2 \cdot e^{-2Y \cdot Z} - 2 \cdot Z^2 \cdot e^{-Z-Y \cdot Z} + Z^2 \cdot e^{-2Z}] + \\
&\quad \frac{k^2}{\rho^2 \cdot \bar{u}^2 \cdot C^2 \cdot D_h^2 \cdot q_w''^2} [16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h] + \\
&\quad \left[\left(\frac{e^{-Y \cdot Z}}{Z} - 1 - \frac{e^{-Z}}{Z} + \frac{Z \cdot e^{-Z}}{2} + Y - \frac{Z \cdot Y^2 \cdot e^{-Z}}{2} \right) + \right. \\
&\quad \left(\frac{S \cdot e^{-Y \cdot Z}}{Z} - S - \frac{S \cdot e^{-Z}}{Z} + \frac{S \cdot Z \cdot e^{-Z}}{2} + S \cdot Y - \frac{S \cdot Y^2 \cdot Z \cdot e^{-Z}}{2} \right) + \\
&\quad \left(\frac{3 \cdot S \cdot S_V \cdot e^{-2Z-Y \cdot Z}}{2 \cdot Z^2} - \frac{3 \cdot S \cdot S_V \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_V \cdot e^{-3Z}}{2 \cdot Z^2} - \right. \\
&\quad \left. \frac{3 \cdot S \cdot S_V \cdot e^{-3Z}}{4} + \frac{3 \cdot S \cdot S_V \cdot Y \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_V \cdot Y^2 \cdot e^{-3Z}}{4} \right) - \\
&\quad \left(\frac{-2 \cdot S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z^2} + \frac{2 \cdot S \cdot S_V \cdot e^{-Z}}{Z} + \frac{2 \cdot S \cdot S_V \cdot e^{-2Z}}{Z^2} - \right. \\
&\quad \left. \frac{S \cdot S_V \cdot e^{-2Z}}{1} - \frac{2 \cdot S \cdot S_V \cdot Y \cdot e^{-Z}}{Z} + \frac{S \cdot S_V \cdot Y^2 \cdot e^{-2Z}}{1} \right) + \\
&\quad \left(\frac{S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z} - \frac{S \cdot S_V \cdot e^{-Z}}{1} - \frac{S \cdot S_V \cdot e^{-2Z}}{Z} + \right. \\
&\quad \left. \frac{S \cdot S_V \cdot Z \cdot e^{-2Z}}{2} + \frac{S \cdot S_V \cdot Y \cdot e^{-Z}}{1} - \frac{S \cdot S_V \cdot Y^2 \cdot e^{-2Z}}{2} \right) + \\
&\quad \left(\frac{S \cdot S_V \cdot e^{-Y \cdot Z}}{2 \cdot Z^2} - \frac{S \cdot S_V}{2 \cdot Z} - \frac{S \cdot S_V \cdot e^{-Z}}{2 \cdot Z^2} + \frac{S \cdot S_V \cdot Z \cdot e^{-Z}}{4 \cdot Z} + \frac{S \cdot S_V \cdot Y}{2 \cdot Z} - \frac{S \cdot S_V \cdot Y^2 \cdot e^{-Z}}{4} \right) + \\
&\quad \left. \left(S - S \cdot Y - \frac{S \cdot S_V \cdot e^{-2Y \cdot Z}}{2 \cdot Z} - \frac{2 \cdot S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z} + \frac{S \cdot S_V \cdot e^{-2Z}}{1} - \frac{3 \cdot S \cdot S_V \cdot e^{-2Z}}{2 \cdot Z} \right) \right] \quad (23)
\end{aligned}$$

Brinkman number (Br) and Peclet number (Pe) are defined as,

$$Br = \frac{u_{\max}^2 \cdot \mu \cdot k \cdot T_0}{q_w''^2 \cdot a^2} \quad \text{and}$$

$$Pe = \frac{\rho \cdot \bar{u} \cdot C \cdot D_h \cdot q_w''}{k} \quad (24)$$

Substituting values of Brinkman number (Br) and Peclet number (Pe) from equation (24)

into equation (23),

$$N_S = Br \cdot [Z^2 \cdot e^{-2Y \cdot Z} - 2 \cdot Z^2 \cdot e^{-Z-Y \cdot Z} + Z^2 \cdot e^{-2 \cdot Z}] + \frac{1}{Pe^2} \cdot [16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h] + [Term1]^2 \quad (25)$$

Here,

$$N_F = Br \cdot [Z^2 \cdot e^{-2Y \cdot Z} - 2 \cdot Z^2 \cdot e^{-Z-Y \cdot Z} + Z^2 \cdot e^{-2 \cdot Z}]$$

$$N_C = \frac{1}{Pe^2} \cdot [16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h] \quad \text{and}$$

$$N_Y = \left[\begin{aligned} & \left(\frac{e^{-Y \cdot Z}}{Z} - 1 - \frac{e^{-Z}}{Z} + \frac{Z \cdot e^{-Z}}{2} + Y - \frac{Z \cdot Y^2 \cdot e^{-Z}}{2} \right) + \\ & \left(\frac{S \cdot e^{-Y \cdot Z}}{Z} - S - \frac{S \cdot e^{-Z}}{Z} + \frac{S \cdot Z \cdot e^{-Z}}{2} + S \cdot Y - \frac{S \cdot Y^2 \cdot Z \cdot e^{-Z}}{2} \right) + \\ & \left(\frac{3 \cdot S \cdot S_V \cdot e^{-2Z-Y \cdot Z}}{2 \cdot Z^2} - \frac{3 \cdot S \cdot S_V \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_V \cdot e^{-3Z}}{2 \cdot Z^2} - \right. \\ & \left. \frac{3 \cdot S \cdot S_V \cdot e^{-3Z}}{4} + \frac{3 \cdot S \cdot S_V \cdot Y \cdot e^{-2Z}}{2 \cdot Z} - \frac{3 \cdot S \cdot S_V \cdot Y^2 \cdot e^{-3Z}}{4} \right) - \\ & \left(\frac{-2 \cdot S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z^2} + \frac{2 \cdot S \cdot S_V \cdot e^{-Z}}{Z} + \frac{2 \cdot S \cdot S_V \cdot e^{-2Z}}{Z^2} - \right. \\ & \left. \frac{S \cdot S_V \cdot e^{-2Z}}{1} - \frac{2 \cdot S \cdot S_V \cdot Y \cdot e^{-Z}}{Z} + \frac{S \cdot S_V \cdot Y^2 \cdot e^{-2Z}}{1} \right) + \\ & \left(\frac{S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z} - \frac{S \cdot S_V \cdot e^{-Z}}{1} - \frac{S \cdot S_V \cdot e^{-2Z}}{Z} + \right. \\ & \left. \frac{S \cdot S_V \cdot Z \cdot e^{-2Z}}{2} + \frac{S \cdot S_V \cdot Y \cdot e^{-Z}}{1} - \frac{S \cdot S_V \cdot Y^2 \cdot e^{-2Z}}{2} \right) + \\ & \left(\frac{S \cdot S_V \cdot e^{-Y \cdot Z}}{2 \cdot Z^2} - \frac{S \cdot S_V}{2 \cdot Z} - \frac{S \cdot S_V \cdot e^{-Z}}{2 \cdot Z^2} + \frac{S \cdot S_V \cdot Z \cdot e^{-Z}}{4 \cdot Z} + \frac{S \cdot S_V \cdot Y}{2 \cdot Z} - \frac{S \cdot S_V \cdot Y^2 \cdot e^{-Z}}{4} \right) + \\ & \left(S - S \cdot Y - \frac{S \cdot S_V \cdot e^{-2Y \cdot Z}}{2 \cdot Z} - \frac{2 \cdot S \cdot S_V \cdot e^{-Z-Y \cdot Z}}{Z} + \frac{S \cdot S_V \cdot e^{-2Z}}{1} - \frac{3 \cdot S \cdot S_V \cdot e^{-2Z}}{2 \cdot Z} \right) \end{aligned} \right]^2$$

Irreversibility Ratio (Φ): -

In our case, both the fluid friction and the heat transfer contribute to the rate of entropy generation. In order to assess which one among the fluid friction and heat transfer dominates, a criterion known as irreversibility ratio is defined by the following equation. Irreversibility ratio (Φ) is the ratio of entropy generation due to the fluid friction to the total entropy generation due to heat transfer.

$$\Phi = \frac{\text{Fluid Friction Component}}{\text{Axial Heat Flux Component} + \text{Transverse Heat Flux Component}}$$
$$\Phi = \frac{N_F}{N_C + N_Y} \quad (26)$$

For $0 \leq \Phi < 1$, the heat transfer dominates the irreversibility ratio and the fluid friction dominates when $\Phi > 1$. The case where both the heat transfer and the fluid friction have the same contribution for the entropy generation is characterized by $\Phi = 1$.

Bejan number (Be): -

Bejan number is the ratio of heat transfer irreversibility to the total irreversibility due to fluid friction and heat transfer.

$$Be = \frac{\text{Heat Flux Components}}{\text{Fluid Friction Component} + \text{Heat Flux Components}}$$
$$Be = \frac{N_C + N_Y}{N_F + N_C + N_Y}$$
$$Be = \frac{1}{1 + \Phi} \quad (27)$$

Bejan number ranges from 0 to 1. $Be = 0$ is the limit where the irreversibility is dominated by fluid frictional effects and $Be = 1$ corresponds to the limit where the irreversibility due to heat transfer by virtue of finite temperature differences dominates.

Similarly, we define the following dimensionless ratios:

$$G_{Friction} = \frac{\textit{Fluid Friction Component}}{\textit{Fluid Friction Component} + \textit{Heat Flux Components}}$$

$$G_F = \frac{N_F}{N_F + N_C + N_Y} \quad (28)$$

and

$$G_{Heat\ Flux} = \frac{\textit{Heat Flux Components}}{\textit{Fluid Friction Component} + \textit{Heat Flux Components}}$$

$$G_H = \frac{N_C + N_Y}{N_F + N_C + N_Y} \quad (29)$$

CHAPTER III

MATHEMATICAL FORMULATION AND ANALYSIS FOR CIRCULAR MICROTUBE

Consider a fully developed electro-osmotically driven flow of an incompressible fluid in a circular microtube with coordinates defined in Figure 2b.

Momentum transport:

For a steady flow without an applied pressure gradient the streamwise momentum equation reduces [18] to

$$\mu \frac{1}{r^n} \frac{d}{dr} \left(r^n \frac{du}{dr} \right) + \frac{\varepsilon}{r^n} \frac{d}{dr} \left(r^n \frac{d\psi}{dr} \right) \frac{d\phi}{dx} = 0 \quad (30)$$

where, $n = 1$ for circular microtube. μ is the fluid viscosity, ε is the dielectric constant, ϕ is the applied potential field and $\psi(r)$ is the access charge distribution.

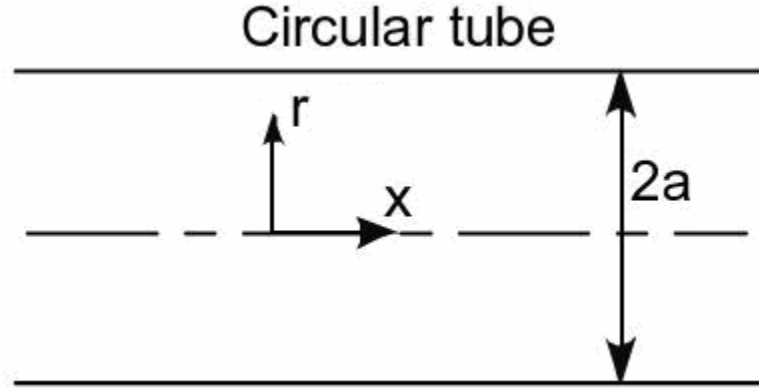


Figure 2b Definition of coordinate system Circular microtube

For low wall potential, the Debye–Huckel linearization is valid [7], and the excess charge distribution may be expressed explicitly as a function only of the zeta potential, the Debye length λ and the radial coordinate r . For such a scenario, the momentum equation may be solved subject to boundary conditions reflecting no slip at the wall and zero shear stress at the centerline, yielding fully-developed electro-osmotic velocity distribution for the circular microtube, as [2,7]

$$\frac{u}{u_{eo}} = 1 - \frac{I_0(Z \cdot R)}{I_0(Z)} \quad (31)$$

where, $R = r/a$ is the normalized radial coordinate, $Z = a/\lambda$ is the Relative duct radius,

I_0 is the modified Bessel function of the first kind of order 0 and its general expression [20] is given by,

$$I_0(x) = 1 + \frac{x^2}{2^2(1!)^2} + \frac{x^4}{2^4(2!)^4} + \frac{x^6}{2^6(3!)^6} + \dots, \quad (32)$$

For our case, considering first few terms for simplification, equation (32) becomes,

$$I_0(Z \cdot R) = 1 + \frac{Z^2 \cdot R^2}{4} + \frac{Z^4 \cdot R^4}{64} \quad (33)$$

The Debye length λ is a function of the electro-chemical characteristics of the liquid / tube interface, and rather difficult to measure. It may be estimated from the relation $\lambda = (\epsilon RT / 2 F^2 z^2 c)^{1/2}$ where ϵ , T , R and F are the fluid permittivity, absolute temperature, universal gas constant, and Faraday's constant respectively. The parameters z and c are the valence number and the average molar concentration of ions in the liquid solution.

Substituting value from equation (33) into equation (31),

$$\frac{u}{u_{\max}} = \frac{16 \cdot Z^2 + Z^4 - 16 \cdot Z^2 \cdot R^2 - Z^4 \cdot R^4}{Z^4 + 16 \cdot Z^2 + 64}$$

Taking partial derivative of the above equation with respect to R ,

$$\frac{\partial \bar{u}}{\partial R} = \frac{-32 \cdot Z^2 \cdot R - 4 \cdot Z^4 \cdot R^3}{Z^4 + 16 \cdot Z^2 + 64} \quad \text{where, } \bar{u} = \frac{u}{u_{\max}}$$

We can also write $\partial u / \partial r$ as,

$$\frac{\partial u}{\partial r} = \frac{\partial \frac{u}{u_{\max}} \cdot u_{\max}}{\partial \frac{r}{a} \cdot a}$$

$$\frac{\partial u}{\partial r} = \frac{u_{\max}}{a} \left(\frac{\partial \bar{u}}{\partial R} \right)$$

$$\left(\frac{\partial u}{\partial r} \right)^2 = \frac{u_{\max}^2}{a^2} \left(\frac{1024 \cdot R^2 \cdot Z^4 + 256 \cdot R^4 \cdot Z^6 + 16 \cdot R^6 \cdot Z^8}{4096 + 2048 \cdot Z^2 + 384 \cdot Z^4 + 32 \cdot Z^6 + Z^8} \right) \quad (34)$$

Energy equation:

Given steady hydrodynamically fully developed flow with constant thermophysical properties, the energy equation simplifies [3] to

$$\frac{\partial^2 T}{\partial x^2} + \frac{1}{r^n} \frac{\partial}{\partial r} \left(r^n \frac{\partial T}{\partial r} \right) = \frac{u}{\alpha} \frac{\partial T}{\partial x} - \frac{s}{k}$$

where, $n = 1$ for the circular microtube. T is the local temperature, α is the thermal diffusivity, k is the thermal conductivity and s is the volumetric Joule heating.

With an imposed constant heat flux boundary condition ($q_w'' = \text{constant}$),

$$\frac{\partial T}{\partial x} = \frac{dT_m}{dx} = \text{Constant}$$

Furthermore, an energy balance on the fluid yields

$$\frac{\partial T}{\partial x} = \frac{4 \cdot q_w''}{\rho \cdot \bar{u} \cdot C \cdot D_h} + \frac{s}{\rho \cdot \bar{u} \cdot C} \quad (35)$$

In the above equation, D_h is the channel hydraulic diameter, q_w'' is the wall heat flux and C is the fluid specific heat.

Performing square of equation (35),

$$\left(\frac{\partial T}{\partial x} \right)^2 = \left(\frac{16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h}{\rho^2 \cdot \bar{u}^2 \cdot C^2 \cdot D_h^2} \right) \quad (36)$$

Now, the general expression for the temperature distribution for circular microtube [6] is,

$$\theta = \{2 + S \cdot [1 + S_v \cdot F(Z)]\} \cdot A_2(R, Z) + S \cdot [A_1(R) - S_v \cdot A_3 \cdot (R, Z)] \quad (37)$$

where, S = dimensionless joule heating parameter, S_v = dimensionless viscous heating

parameter and $\theta = \frac{k \cdot T}{a \cdot q_w''} = \text{normalized temperature}$. Also,

$$F(Z) = \frac{I_1^2(Z)}{I_0^2(Z)} + \frac{2}{Z} \frac{I_1(Z)}{I_0(Z)} - 1 \quad (38)$$

$$A_1(R) = -\frac{1}{4}(R^2 - 1) \quad (39)$$

$$A_2(R, Z) = \frac{1}{Z^2} \left[1 - \frac{I_0(R \cdot Z)}{I_0(Z)} \right] + \frac{1}{4} (R^2 - 1) \quad (40)$$

and

$$A_3(R, Z) = \frac{1}{2} \left[1 - \frac{I_1^2(Z)}{I_0^2(Z)} \right] + \frac{1}{2 \cdot Z} \left[R \cdot \frac{I_1(R \cdot Z) \cdot I_0(R \cdot Z)}{I_0^2(Z)} - \frac{I_1(Z)}{I_0(Z)} \right] + \frac{1}{2 \cdot Z^2} \left[\frac{I_0^2(R \cdot Z)}{I_0^2(Z)} - 1 \right] - \frac{R^2}{2} \left[\frac{I_0^2(R \cdot Z)}{I_0^2(Z)} - \frac{I_1^2(R \cdot Z)}{I_0^2(Z)} \right] \quad (41)$$

In the above equations, I_1 is the modified Bessel function of the first kind of order 1 and its general expression [5] is given by,

$$I_1(x) = \frac{x}{2} + \frac{x^3}{2^3 \cdot 1!2!} + \frac{x^5}{2^5 \cdot 2!3!} + \frac{x^7}{2^7 \cdot 3!4!} + \dots, \quad (42)$$

For our case, considering first few terms for simplification, equation (42) becomes,

$$I_1(R \cdot Z) = \frac{R \cdot Z}{2} + \frac{(R \cdot Z)^3}{16} + \frac{(R \cdot Z)^5}{384} \quad (43)$$

Substituting the values of equations (38), (39), (40), (41) and (43) into equation (37),

$$\theta = \left\{ 2 + S \cdot \left[1 + S_v \cdot \left(\frac{I_1^2(Z)}{I_0^2(Z)} + \frac{2}{Z} \frac{I_1(Z)}{I_0(Z)} - 1 \right) \right] \right\} \cdot \left(\frac{1}{Z^2} \left[1 - \frac{I_0(R \cdot Z)}{I_0(Z)} \right] + \frac{1}{4} (R^2 - 1) \right) + S \cdot \left[\left(-\frac{1}{4} (R^2 - 1) \right) - S_v \cdot \left(\frac{1}{2} \left[1 - \frac{I_1^2(Z)}{I_0^2(Z)} \right] + \frac{1}{2 \cdot Z} \left[R \cdot \frac{I_1(R \cdot Z) \cdot I_0(R \cdot Z)}{I_0^2(Z)} - \frac{I_1(Z)}{I_0(Z)} \right] + \frac{1}{2 \cdot Z^2} \left[\frac{I_0^2(R \cdot Z)}{I_0^2(Z)} - 1 \right] - \frac{R^2}{2} \left[\frac{I_0^2(R \cdot Z)}{I_0^2(Z)} - \frac{I_1^2(R \cdot Z)}{I_0^2(Z)} \right] \right) \right] \quad (44)$$

Taking partial derivative of equation (44) with respect to R and taking square using Mathematica,

$$\left(\frac{\partial \theta}{\partial R}\right)^2 = [Term\ 2]^2 \quad (45)$$

Also, we know,

$$\theta = \frac{k \cdot T}{a \cdot q_w''} \quad (46)$$

$$\left(\frac{\partial T}{\partial R}\right)^2 = \left(\frac{a \cdot q_w''}{k}\right)^2 \cdot \left(\frac{\partial \theta}{\partial R}\right)^2 \quad (47)$$

Substituting value of equation (45) into equation (47),

$$\left(\frac{\partial T}{\partial R}\right)^2 = \left(\frac{a \cdot q_w''}{k}\right)^2 \cdot [Term\ 2]^2 \quad (48)$$

We can also write $\partial T / \partial R$ as,

$$\left(\frac{\partial T}{\partial R}\right) = \left(\frac{\partial T}{\partial R \cdot a \cdot 1/a}\right)$$

$$\left(\frac{\partial T}{\partial R}\right)^2 = a^2 \left(\frac{\partial T}{\partial r}\right)^2 \quad (49)$$

Comparing equations (48) and (49),

$$\left(\frac{\partial T}{\partial r}\right)^2 = \left(\frac{q_w''}{k}\right)^2 \cdot [Term\ 2]^2 \quad (50)$$

Flow and heat transfer processes inside the tube are irreversible. The non-equilibrium conditions arise due to the exchange of energy, mass and momentum within the fluid and at solid boundaries, thus resulting in entropy generation. A part of the entropy production is due to the heat transfer in the direction of finite temperature and the other part of entropy production arises due to the fluid friction.

The equation for the entropy generation per unit volume for a circular microtube is given by

$$S_G''' = \frac{\mu}{T_0} \left(\frac{\partial u}{\partial r} \right)^2 + \frac{k}{T_0^2} \left[\left(\frac{\partial T}{\partial x} \right)^2 + \left(\frac{\partial T}{\partial r} \right)^2 \right] \quad (51)$$

In the above equation,

$$\frac{\mu}{T_0} \left(\frac{\partial u}{\partial r} \right)^2 = \text{friction component}$$

$$\frac{k}{T_0^2} \left[\left(\frac{\partial T}{\partial x} \right)^2 + \left(\frac{\partial T}{\partial r} \right)^2 \right] = \text{heat flux component}$$

here, $\frac{k}{T_0^2} \left(\frac{\partial T}{\partial x} \right)^2 =$ axial heat flux component and $\frac{k}{T_0^2} \left(\frac{\partial T}{\partial r} \right)^2 =$ radial heat flux component

Multiplying both sides by $k \cdot T_0^2 / q_w''^2$ to get the value of N_S ,

$$\left(\frac{k \cdot T_0^2}{q_w''^2} \right) S_G''' = N_S = \frac{\mu \cdot k \cdot T_0}{q_w''^2} \left(\frac{\partial u}{\partial r} \right)^2 + \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial x} \right)^2 + \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial r} \right)^2 \quad (52)$$

$$N_S = N_F + N_C + N_R \quad (53)$$

In the above equations,

N_S = Dimensionless entropy generation number

$$N_F = \frac{\mu \cdot k \cdot T_0}{q_w''^2} \left(\frac{\partial u}{\partial r} \right)^2 = \text{entropy generation due to the fluid friction}$$

$$N_C = \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial x} \right)^2 = \text{entropy generation due to heat transfer in the axial direction}$$

$$N_R = \frac{k^2}{q_w''^2} \left(\frac{\partial T}{\partial r} \right)^2 = \text{entropy generation due to heat transfer in the radial direction}$$

Substituting values from equations (34), (36) and (50) into equation (52),

$$N_s = \frac{u_{\max}^2 \cdot \mu \cdot k \cdot T_0}{q_w''^2 \cdot a^2} \left[\frac{1024 \cdot R^2 \cdot Z^4 + 256 \cdot R^4 \cdot Z^6 + 16 \cdot R^6 \cdot Z^8}{4096 + 2048 \cdot Z^2 + 384 \cdot Z^4 + 32 \cdot Z^6 + Z^8} \right] + \frac{k^2}{\rho^2 \cdot \bar{u}^2 \cdot C^2 \cdot D_h^2 \cdot q_w''^2} \left[16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h \right] + [Term\ 2]^2 \quad (54)$$

Taking values of Brinkman number (Br) and Peclet number (Pe) from equation (24) and substituting into equation (54),

$$N_s = Br \cdot \left[\frac{1024 \cdot R^2 \cdot Z^4 + 256 \cdot R^4 \cdot Z^6 + 16 \cdot R^6 \cdot Z^8}{4096 + 2048 \cdot Z^2 + 384 \cdot Z^4 + 32 \cdot Z^6 + Z^8} \right] + \frac{1}{Pe^2} \left[16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h \right] + (Term\ 2)^2 \quad (55)$$

here,

$$N_F = Br \cdot \left[\frac{1024 \cdot R^2 \cdot Z^4 + 256 \cdot R^4 \cdot Z^6 + 16 \cdot R^6 \cdot Z^8}{4096 + 2048 \cdot Z^2 + 384 \cdot Z^4 + 32 \cdot Z^6 + Z^8} \right]$$

$$N_C = \frac{1}{Pe^2} \cdot \left[16 \cdot q_w''^2 + s^2 \cdot D_h^2 + 8 \cdot q_w'' \cdot s \cdot D_h \right]$$

and

$$N_R = Term\ 2$$

Irreversibility Ratio (Φ): -

In the case of circular microtube,

$$\Phi = \frac{\text{Fluid Friction Component}}{\text{Axial Heat Flux Component} + \text{Radial Heat Flux Component}}$$

$$\Phi = \frac{N_F}{N_C + N_R} \quad (56)$$

Bejan number (Be): -

In the case of circular microtube,

$$Be = \frac{\text{Heat Flux Components}}{\text{Fluid Friction Component} + \text{Heat Flux Components}}$$

$$Be = \frac{N_C + N_R}{N_F + N_C + N_R}$$

$$Be = \frac{1}{1 + \Phi} \quad (57)$$

Similarly, we can define the following dimensionless ratios:

$$G_{Friction} = \frac{\text{Fluid Friction Component}}{\text{Fluid Friction Component} + \text{Heat Flux Components}}$$

$$G_F = \frac{N_F}{N_F + N_C + N_R} \quad (58)$$

$$G_{Axial} = \frac{\text{Axial Heat Flux Components}}{\text{Fluid Friction Component} + \text{Heat Flux Components}}$$

$$G_C = \frac{N_C}{N_F + N_C + N_R} \quad (59)$$

and

$$G_{Radial} = \frac{\text{Radial Heat Flux Components}}{\text{Fluid Friction Component} + \text{Heat Flux Components}}$$

$$G_R = \frac{N_R}{N_F + N_C + N_R} \quad (60)$$

CHAPTER IV

DISCUSSION OF RESULTS

We have presented an analysis for the entropy generation on thermally fully developed, electro-osmotically generated flow for a parallel plate microchannel and a circular microtube under constant wall heat flux boundary condition. The fluid is assumed to be water. The velocity and the temperature distributions are obtained analytically from the momentum equation and energy equation and used to compute the entropy generation, dimensionless entropy generation number (N_s), Irreversibility ratio (Φ), Bejan number (Be) and the dimensionless ratios: G_fluid friction (G_f) and G_heat flux (G_H). These parameters are presented graphically for various values of dimensionless joule heating parameter (S), dimensionless viscous heating parameter (S_v), relative duct radius (Z), Brinkman number (Br) and Peclet number (Pe).

Parallel plate microchannel:

Figure 3 shows the distribution of dimensionless entropy generation number N_s for constant values of S , S_v , Z and Pe . Here, Brinkman number Br is chosen as a

parameter ranging from 0.2 to 1.0. From the figure, it is clear that N_s decreases as Y increases. Also as the value of Br increases, N_s also increases for a given value of Y . Figure 4 displays the Bejan number Be versus Y . Be is the ratio of heat transfer irreversibility to the total irreversibility due to fluid friction and heat transfer. Bejan number increases as the value of Y increases and approaches 1. Also as the value of Br increases, Be decreases. In Figure 5, Irreversibility ratio Φ is plotted versus Y . Irreversibility ratio Φ is the ratio of entropy generation due to the fluid friction to the total entropy generation due to heat transfer. Irreversibility ratio decreases as the value of Y increases and approaches 0. For $0 \leq \Phi < 1$, the heat transfer dominates the irreversibility ratio and the fluid friction dominates when $\Phi > 1$. Also it can be noted that as the value of Br increases, Φ increases. Figures 6 and 7 show the dimensionless ratios G_f and G_h versus Y . Looking at the equations and plots, the plots for G_f are similar to Φ and the plots for G_h are similar to Be . Figure 8 shows the entropy generation due to fluid friction N_f versus Y . It can be seen that as the value of Br increases, N_f increases for a particular value of Y . In Figure 9, N_h is plotted versus N_f . It can be seen that for a particular value of N_f , the value of N_h increases as Br increases.

In Figure 10, N_s is plotted versus Y for constant values of S , S_v , Br and Pe . Here relative duct radius Z is chosen as a parameter ranging from 6.5 to 15. It can be seen that as Z increases, N_s also increases. From Figures 11 and 12, it is clear that as the value of Z increases, Be decreases and Φ increases for any value of Y . Figures 15 and 16 show N_f and N_h versus Y respectively. It can be seen here that as Z increases, value of N_f and N_h also increases. In Figure 18, N_s is plotted versus Y for constant values of S , S_v , Br and Z . Here Peclet number Pe is chosen as a parameter ranging from 2 to 10. It can be seen that

as the value of Pe increases, N_s decreases. From Figures 19 and 20, it is clear that as the value of Pe increases, Be decreases and Φ increases for any value of Y . Figures 23 and 24 show N_c and N_h versus Y respectively. It can be seen here that as Pe increases, value of N_c and N_h decreases. From Figure 25 it can be seen that, for any given value of N_h , N_f decreases with the increase in the value of Pe .

In Figure 26, N_s is plotted versus Y for constant values of Pe , S_v , Br and Z . Here dimensionless joule heating parameter S is chosen as a parameter ranging from 1 to 5. It can be seen that as the value of S increases, N_s also increases. From Figures 27 and 28, it is clear that as the value of S increases, Be increases and Φ decreases for any value of Y . In Figure 31, N_h is plotted versus Y . It can be seen here that as S increases, value of N_h also increases. From Figure 32, it can be seen that for any given value of N_h , as S increases, N_f also increases. In Figure 33, N_s is plotted versus Y for constant values of Pe , S , Br and Z . Here dimensionless viscous heating parameter S_v is chosen as a parameter ranging from 1 to 5. It can be seen that as the value of S_v increases, N_s decreases. From Figures 34 and 35, it is clear that as the value of S_v increases, Be decreases and Φ increases for any value of Y . In Figure 38, N_f is plotted versus Y . It can be seen here that as Y increases, value of N_f decreases and it is independent of S_v . We can see from Figure 39 that N_h decreases with increase in S_v . From Figure 40, it is clear that for any given value of N_h , as S_v increases, N_f decreases.

Circular microtube:

Figure 41 shows the distribution of dimensionless entropy generation number N_s for constant values of S , S_v , Z and Pe . Here Brinkman number Br is chosen as a

parameter ranging from 0.2 to 1.0. From the figure, it is clear that N_s decreases as we go towards the center of the tube. Also as the value of Br increases, N_s also increases for a given value of R . Figure 42 displays the Bejan number Be versus R . As the value of Br increases, Be decreases. In Figure 43, Irreversibility ratio Φ is plotted versus R . It can be noted that as the value of Br increases, Φ also increases. Figures 44 and 45 show the dimensionless ratios G_f and G_r versus R . Figure 46 shows the entropy generation due to fluid friction N_f versus R . It can be seen that as the value of Br increases, N_f increases for a particular value of R .

In Figure 47, N_s is plotted versus R for constant values of S , S_v , Br and Pe . Here relative duct radius Z is chosen as a parameter ranging from 6.5 to 15. From Figures 48 and 49, it is clear that as the value of Z increases, Be decreases and Φ increases for any value of R . Figures 52 and 53 shows N_f and N_h versus R respectively. It can be seen here that as Z increases, value of N_f and N_h also increases. In Figure 54, N_s is plotted versus R for constant values of S , S_v , Br and Z . Here Peclet number Pe is chosen as a parameter ranging from 2 to 10. It can be seen that as the value of Pe increases, N_s decreases. From Figures 55 and 56, it is clear that as the value of Pe increases, Be decreases and Φ increases for any value of R . Figures 59 and 60 shows N_c and N_h versus R respectively. It can be seen here that as Pe increases, value of N_c and N_h decreases.

In Figure 61, N_s is plotted versus R for constant values of Pe , S_v , Br and Z . Here dimensionless joule heating parameter S is chosen as a parameter ranging from 1 to 16. It can be seen that as the value of S increases, N_s also increases. From Figures 62 and 63, it is clear that as the value of S increases, Be increases and Φ decreases for any value of R . In Figure 67, N_h is plotted versus R . It can be seen here that as S increases, value of N_h

also increases. In Figure 68, N_s is plotted versus R for constant values of Pe , S , Br and Z . Here dimensionless viscous heating parameter S_v is chosen as a parameter ranging from 1 to 16. It can be seen that as the value of S_v increases, N_s decreases. From Figures 69 and 70, it is clear that as the value of S_v increases, Be decreases and Φ increases for any value of R . We can see from Figure 74 that N_h decreases with increase in S_v .

We have analyzed the nature of various plots for thermally fully developed, electro-osmotically generated flow for a parallel plate microchannel and a circular microtube under constant wall heat flux boundary condition. Similar kind of results can be obtained by applying constant wall temperature boundary condition.

CHAPTER V

CONCLUDING REMARKS

We have considered thermally fully developed electro-osmotically generated flow which is established by a voltage potential gradient along the length of a channel or a tube. We have provided an analysis for the entropy generated in a parallel plate microchannel and a circular microtube. The boundary condition considered in our case is constant wall heat flux. We have identified five different variables namely, (i) dimensionless joule heating parameter, (ii) dimensionless viscous heating parameter, (iii) relative duct radius, (iv) Peclet number and (v) Brinkman number from the dimensionless entropy generation number equation. We have analyzed the nature of various results for dimensionless entropy generation number, Bejan number, Irreversibility ratio, entropy generation due to fluid friction, entropy generation due to heat transfer in the axial and transverse direction etc. and discussed the effects of each of those five variables on these parameters for both the configurations. We have coded the required MATLAB programs used to generate the plots in the present work and they are given in the appendix.

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I. Variables used in the MATLAB Programs

Variables used in equations	Variables used in programs
Dimensionless joule heating parameter (S)	S
Dimensionless viscous heating parameter (S_v)	S_v
Relative duct radius (Z)	Z
Peclet number (Pe)	Pe
Wall heat flux (q_w'')	q
channel hydraulic diameter (Dh)	Dh
Entropy generation due to heat transfer in the transverse direction (N_Y)	Ny
Entropy generation due to heat transfer in the axial direction (N_C)	Nc
Entropy generation due to heat transfer in the axial and transverse direction (N_H)	Nh
Entropy generation due to fluid friction (N_F)	Nf
Dimensionless entropy generation number (N_S)	Ns
Irreversibility ratio (Φ)	Phi
Bejan number (Be)	Be
G_axial (G_C)	Gc
G_fluid friction (G_F)	Gf

G_heat flux (G_H)	Gh
G_radial (G_R)	Gr
Brinkman number (Br)	Br
Normalized wall-normal coordinate ($Y = y/a$)	Y
Normalized radial coordinate ($R = r/a$)	R

**FIGURES FOR
PARALLEL PLATE MICROCHANNEL**

Figure 3. Ns Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

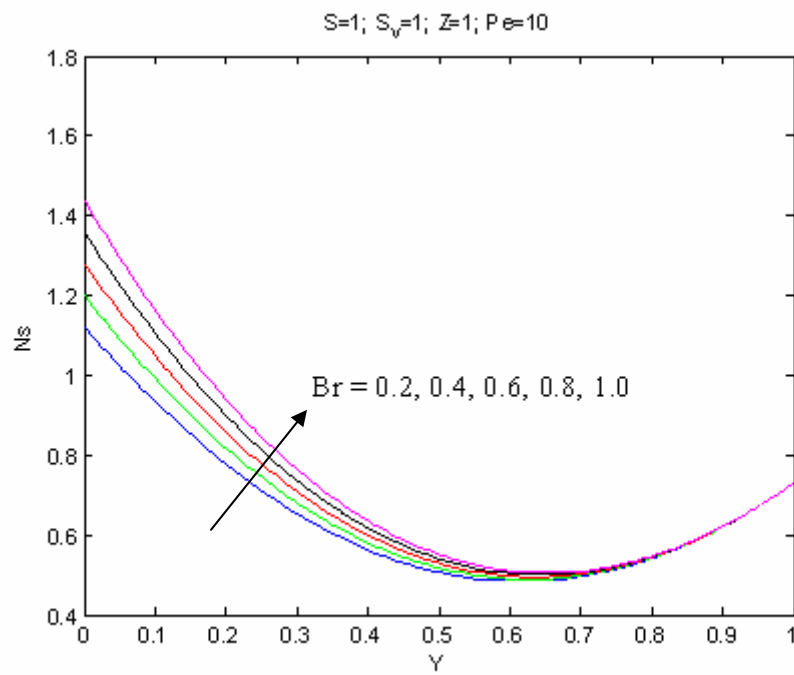


Figure 4. Be Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

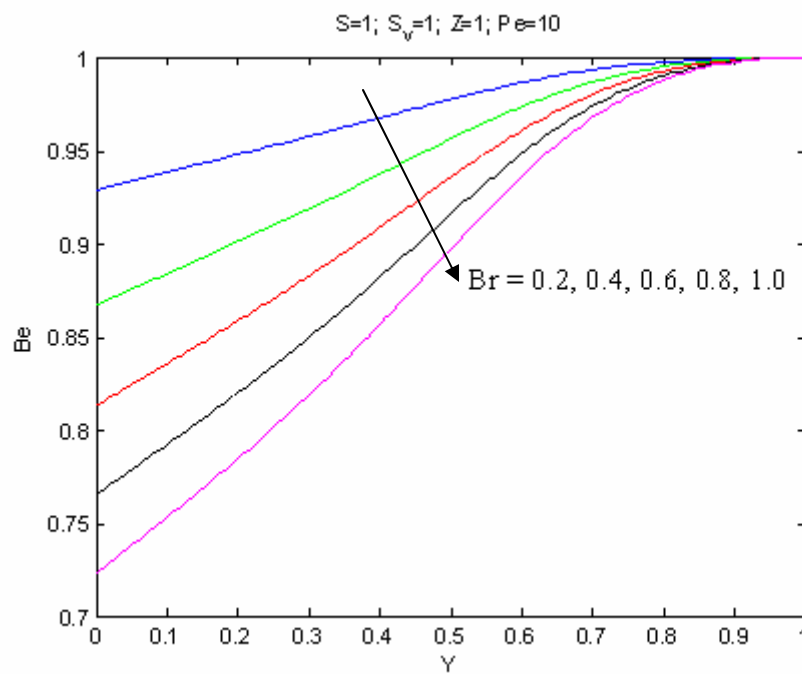


Figure 5. Φ Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

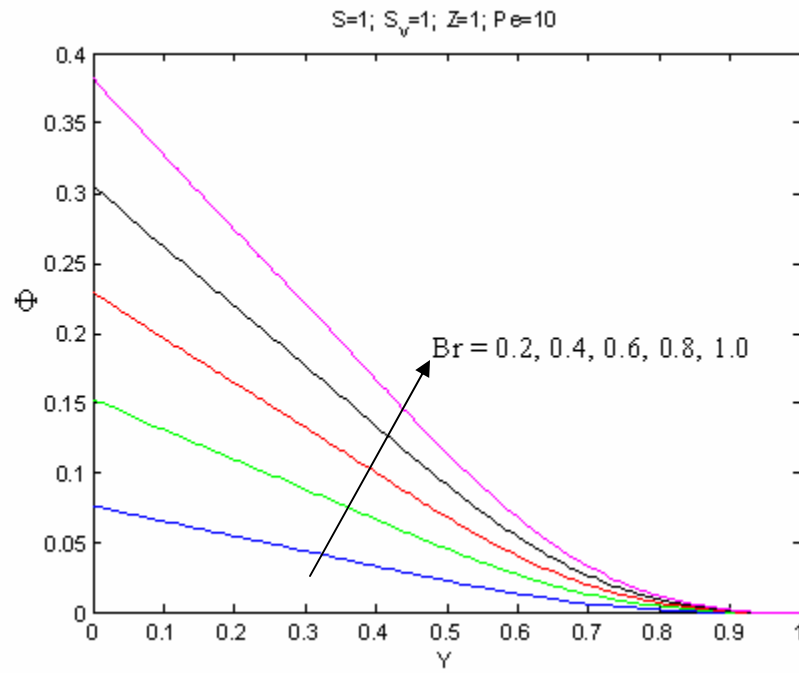


Figure 6. Gf Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

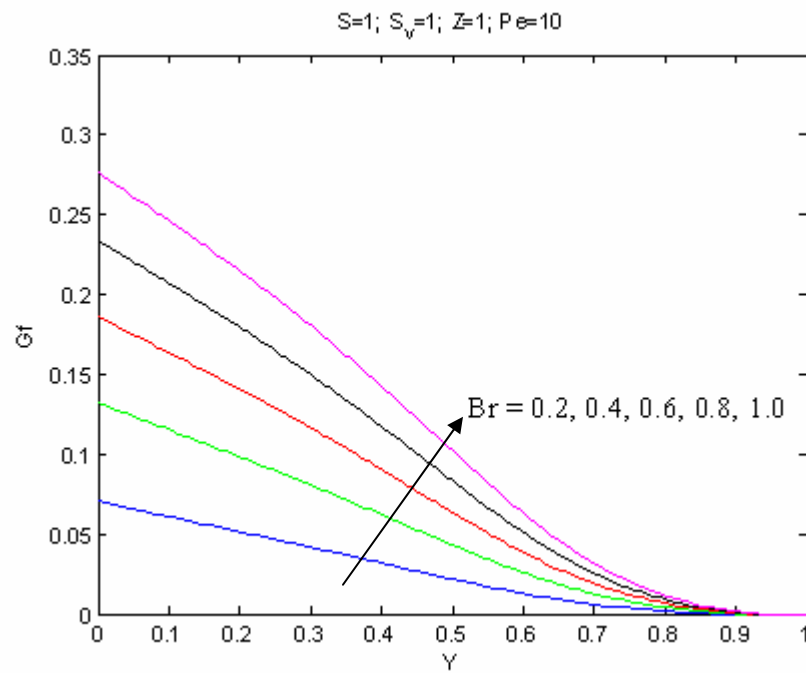


Figure 7. Gh Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

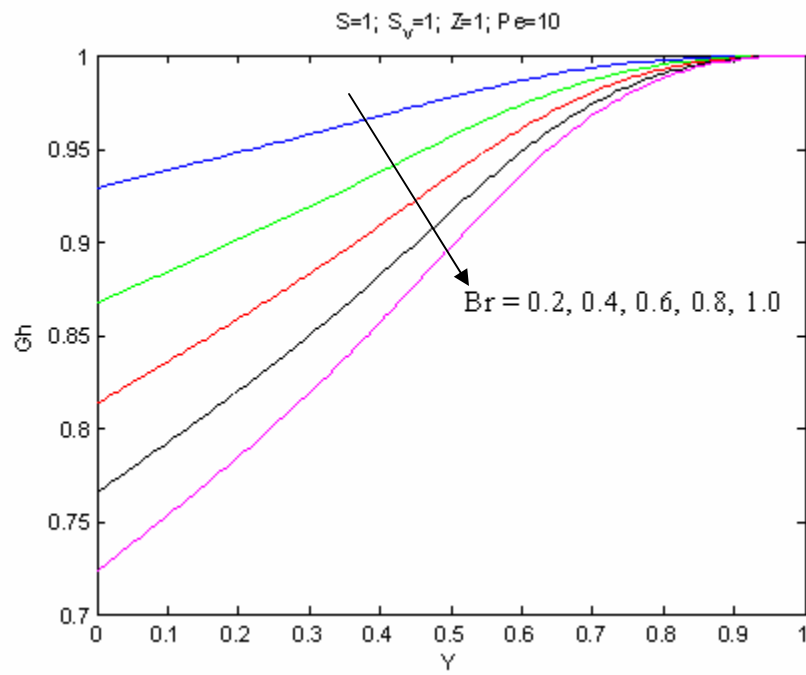


Figure 8. Nf Vs Y for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

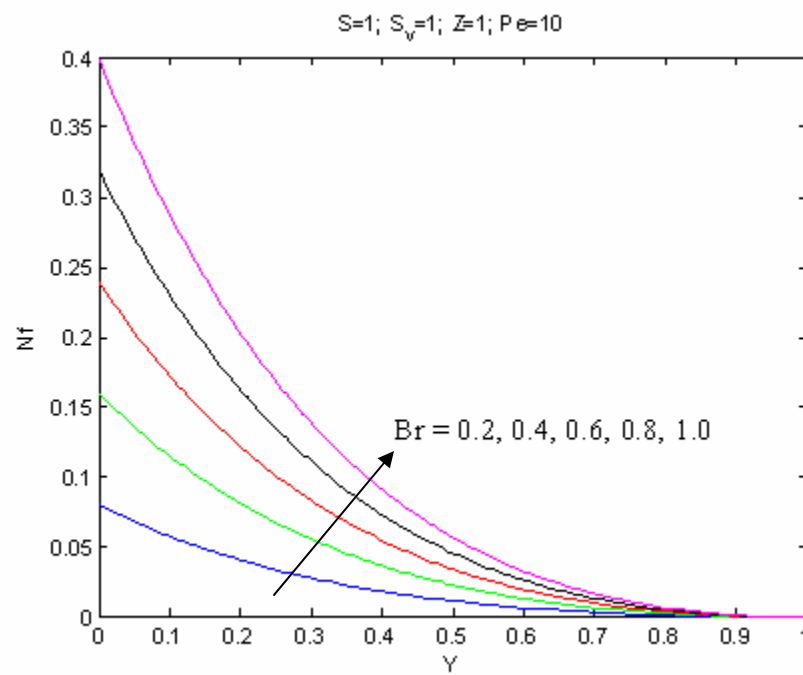


Figure 9. Nh Vs Nf for S=1; Sv=1; Z=1; Pe=10 and Br=0.2, 0.4, 0.6, 0.8 & 1.0

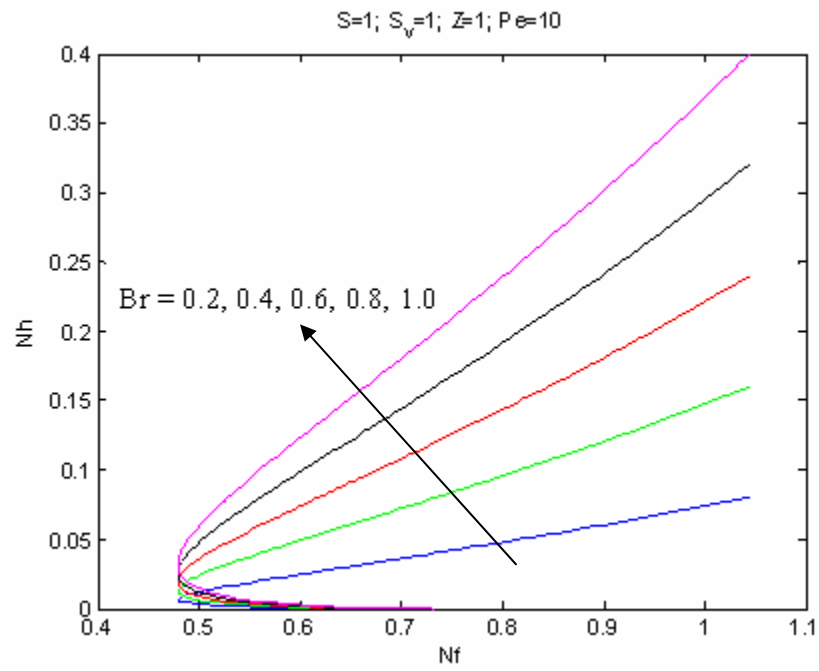


Figure 10. Ns Vs Y for S=1; Sv=1; Br=1; Pe=10 and Z=6.5, 7.5, 10, 12.5 & 15

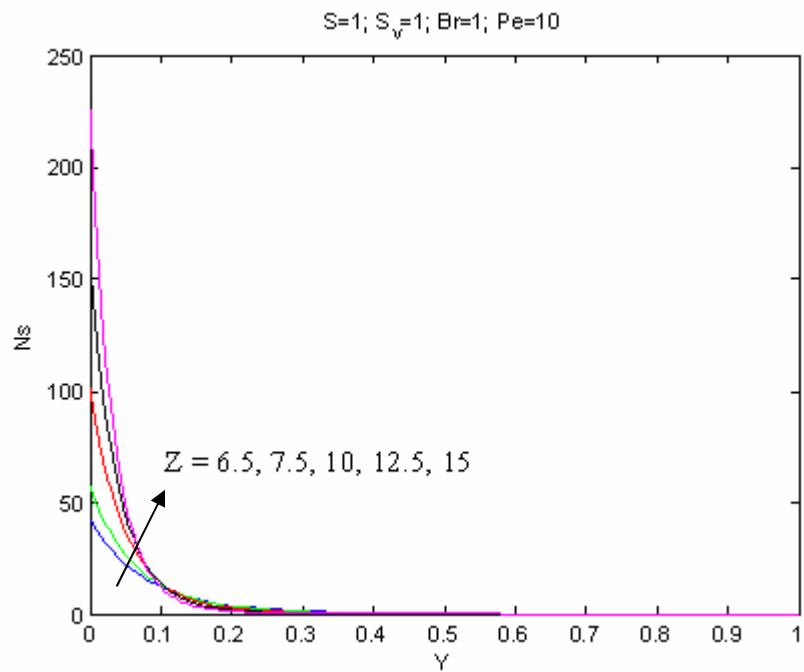


Figure 11. Be Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

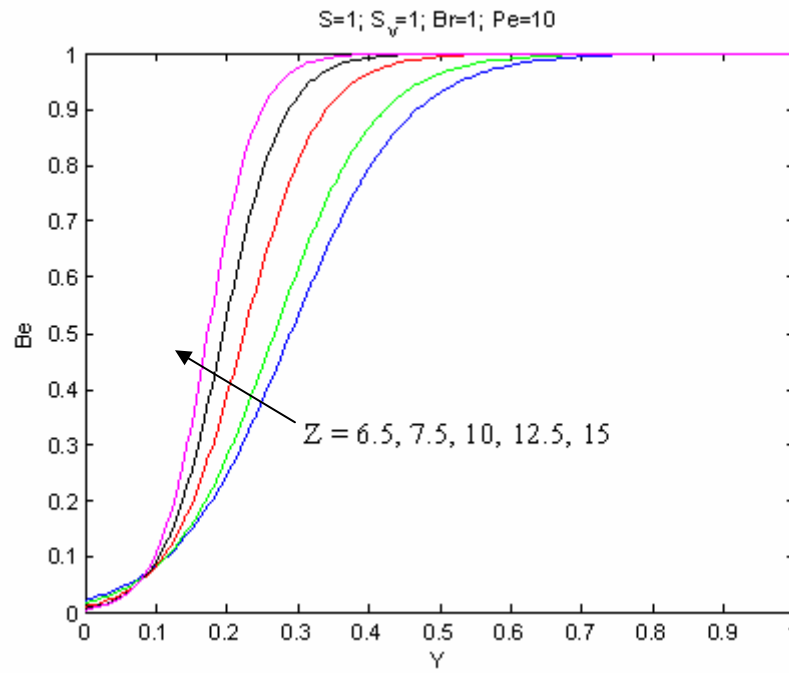


Figure 12. Φ Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

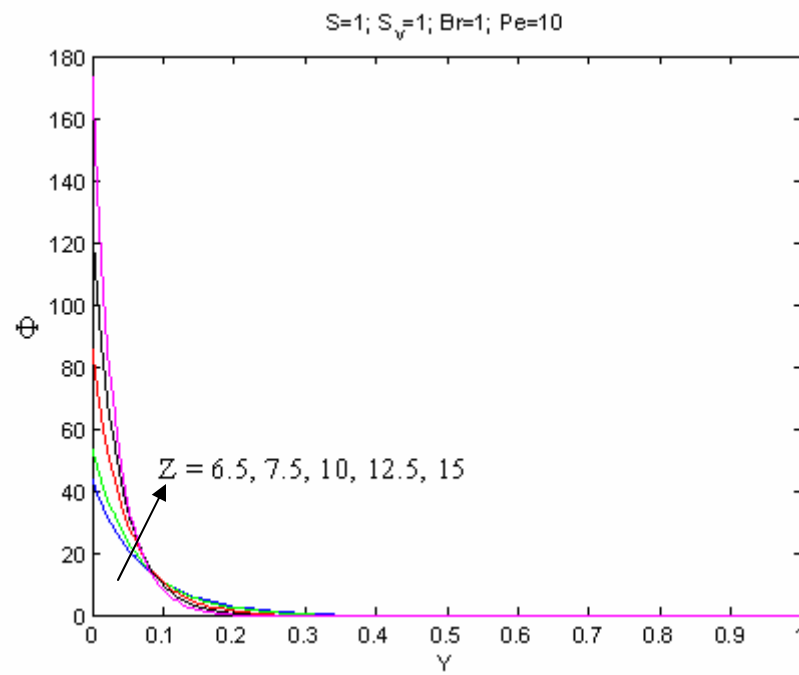


Figure 13. Gf Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

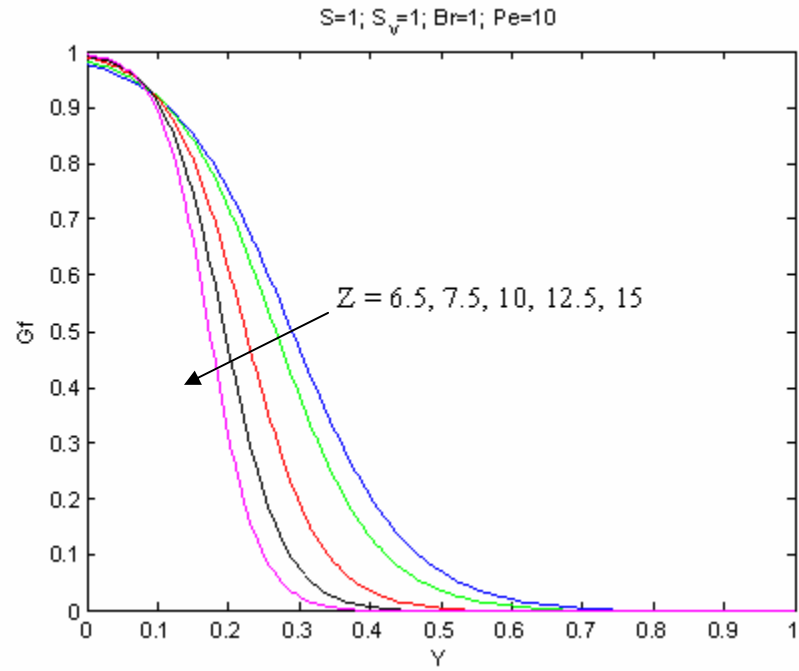


Figure 14. Gh Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

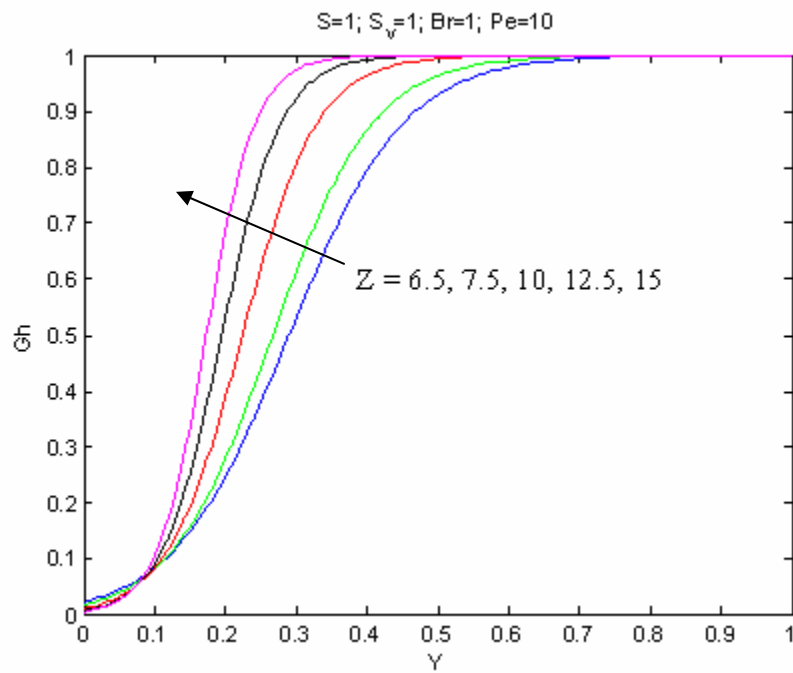


Figure 15. N_f Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

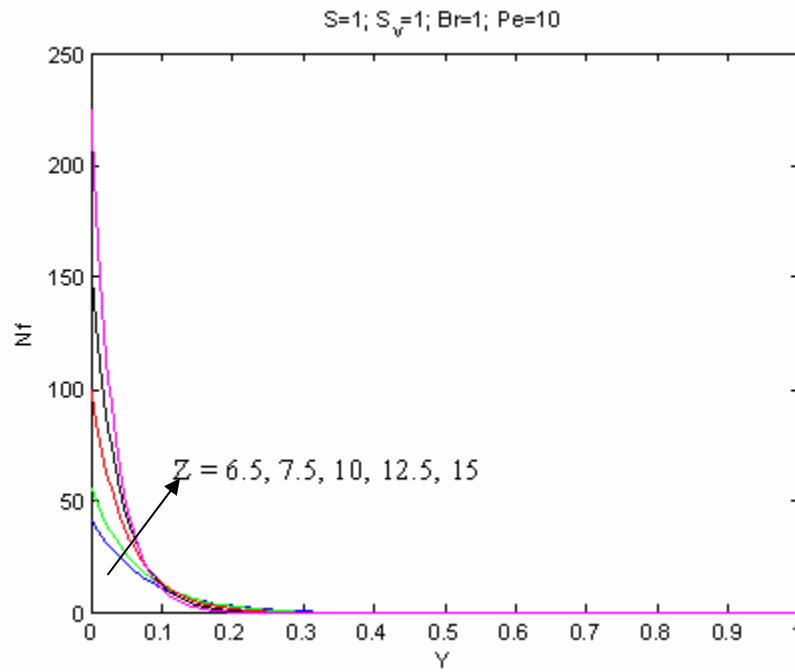


Figure 16. N_h Vs Y for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

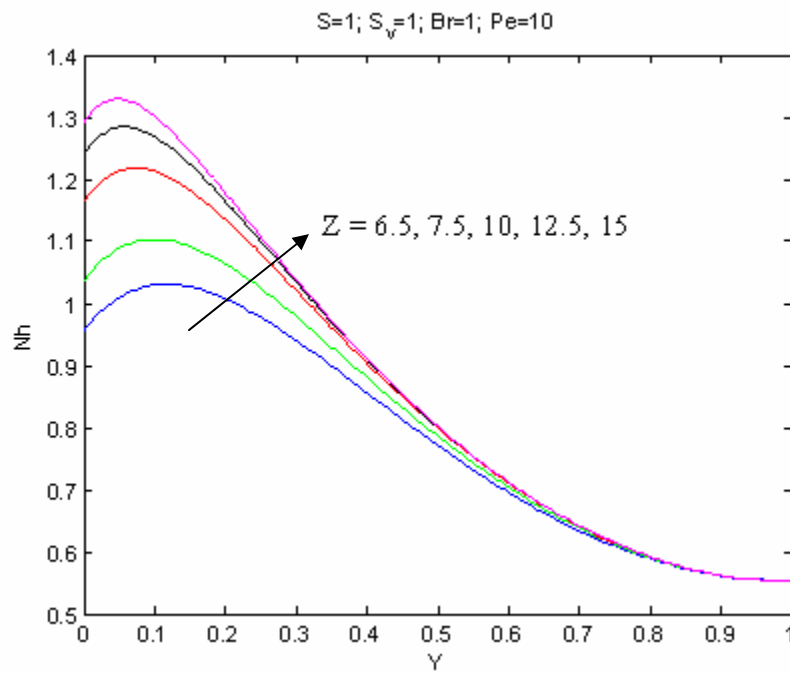


Figure 17. Nh Vs Nf for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

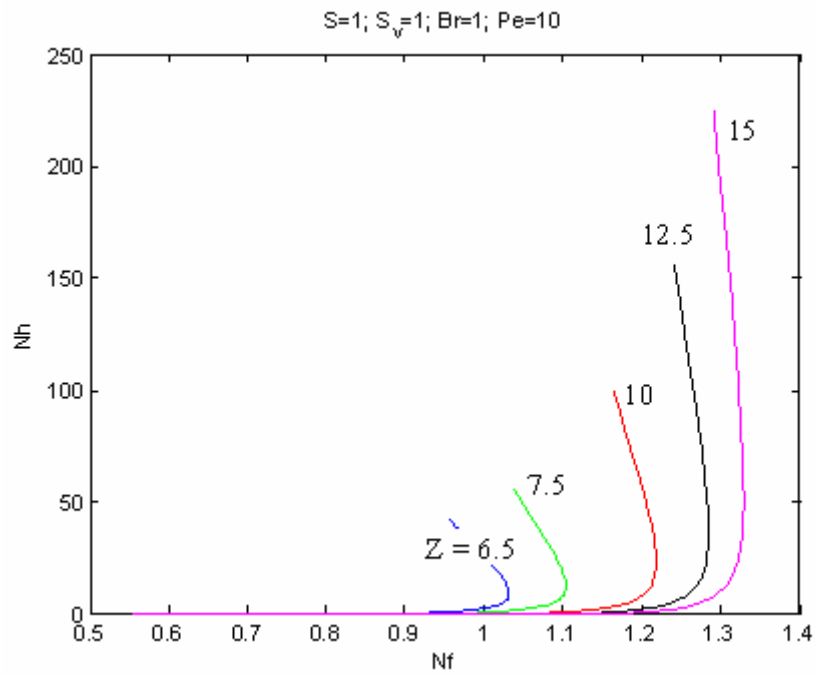


Figure 18. Ns Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

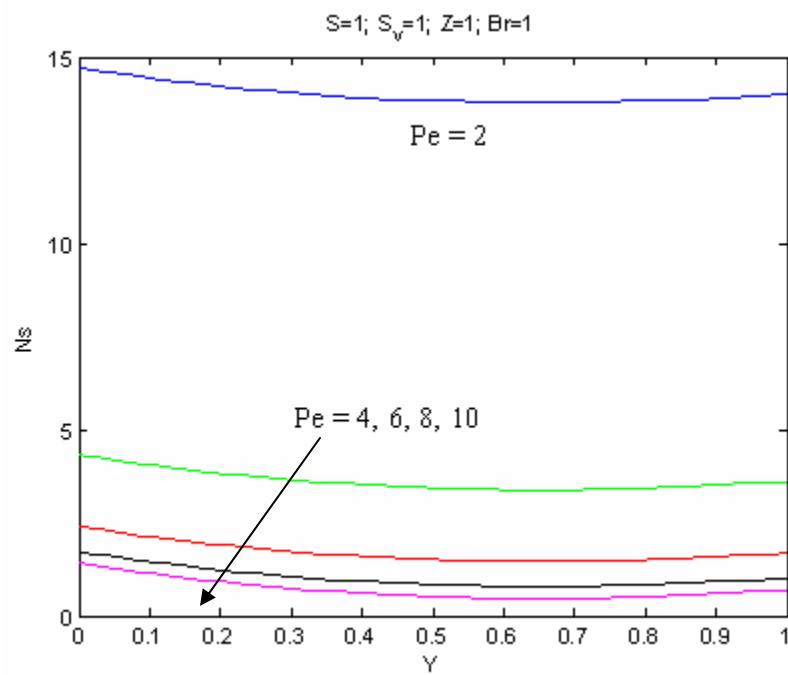


Figure 19. Be Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

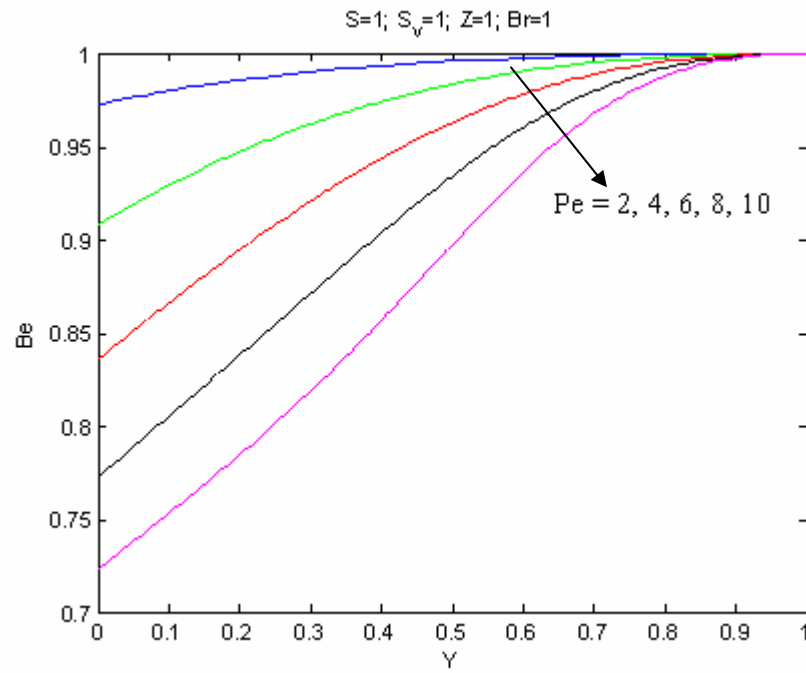


Figure 20. Φ Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

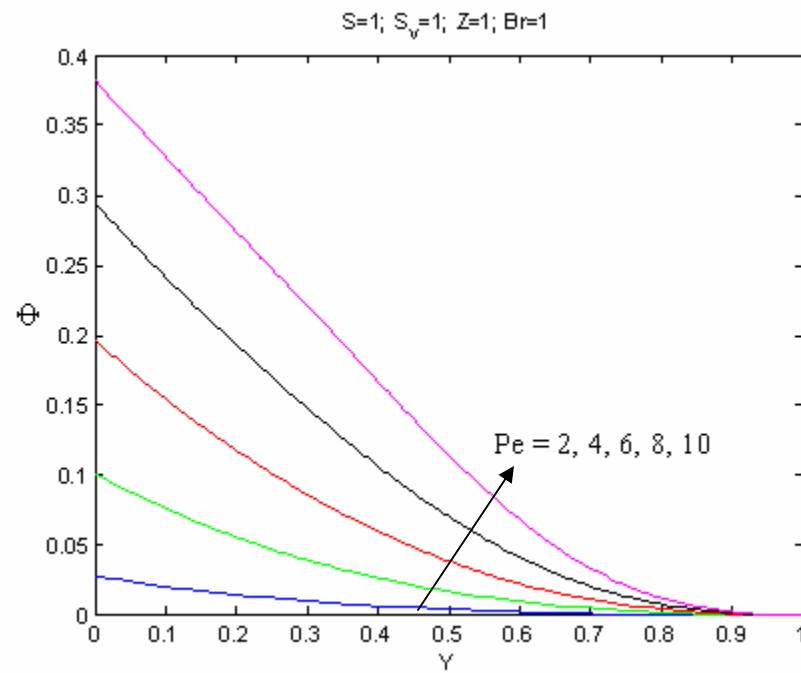


Figure 21. Gf Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

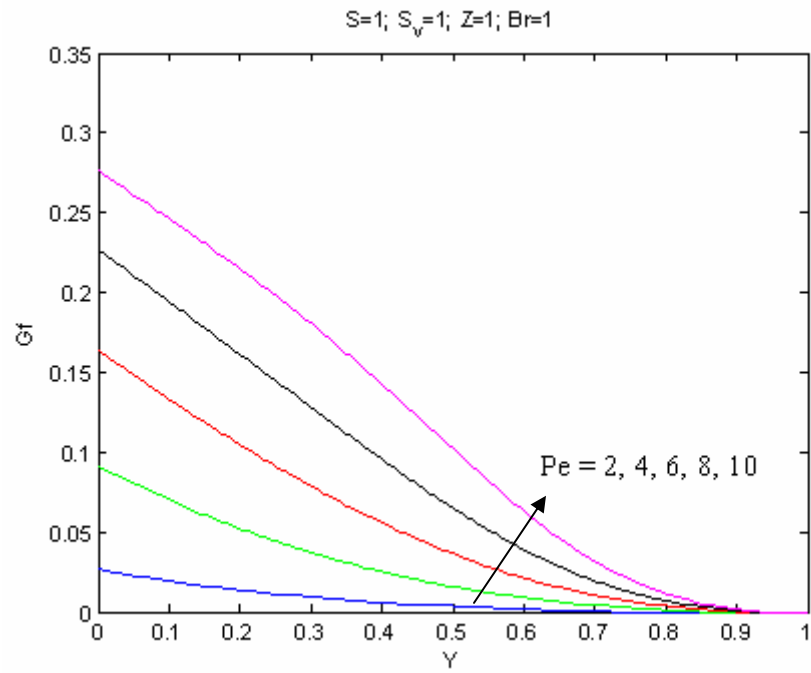


Figure 22. Gh Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

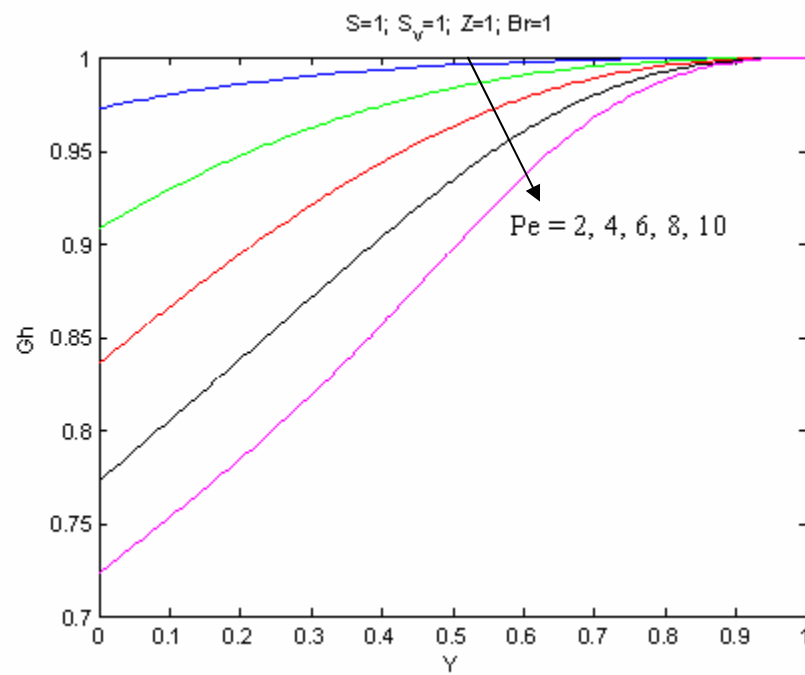


Figure 23. N_c Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

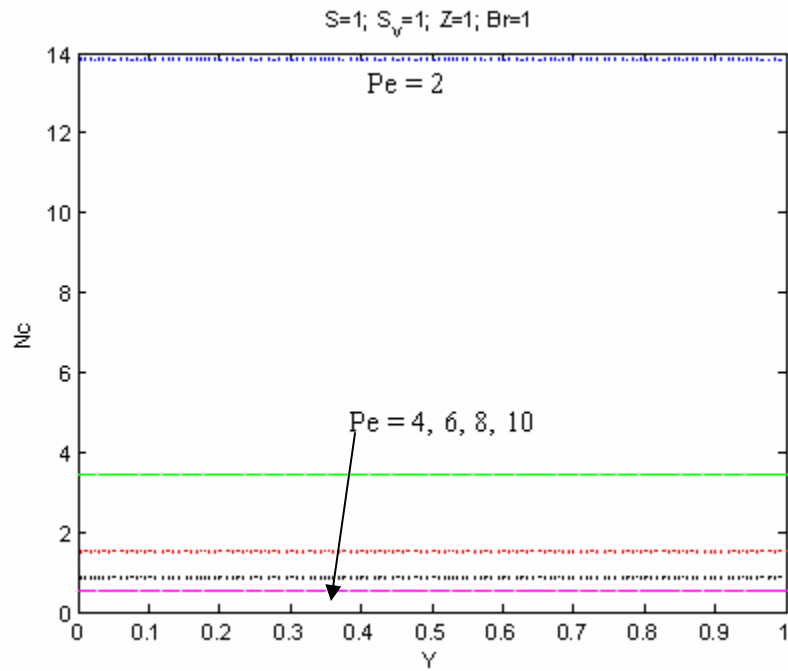


Figure 24. N_h Vs Y for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

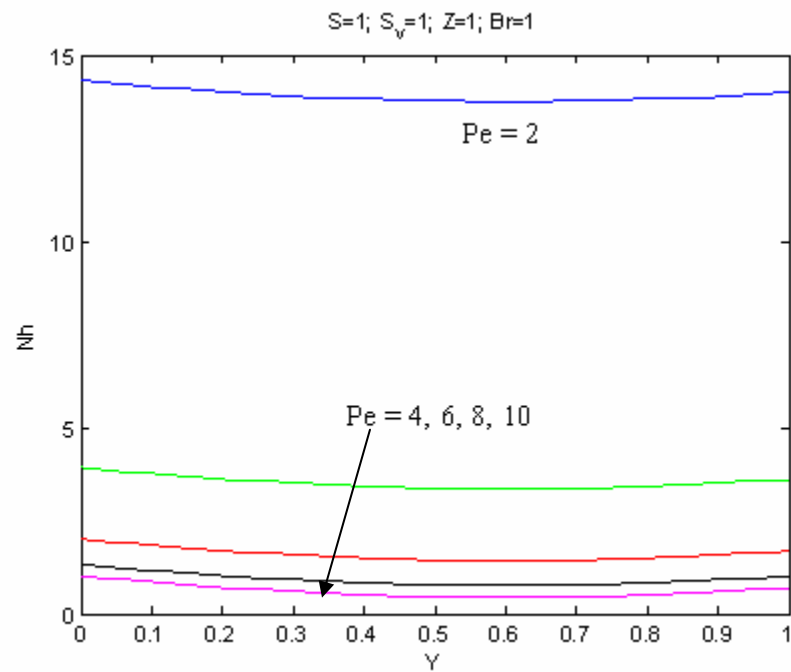


Figure 25. Nh Vs Nf for S=1; Sv=1; Z=1; Br=1 and Pe=2, 4, 6, 8 & 10

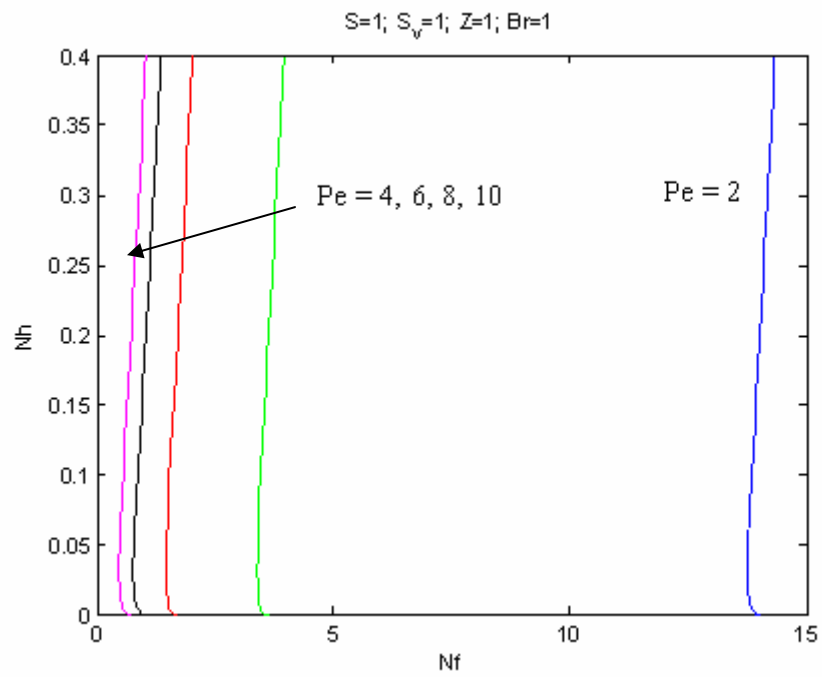


Figure 26. Ns Vs Y for Sv=1; Z=1; Br=1; Pe=2.5 and S=1, 2, 3, 4 & 5

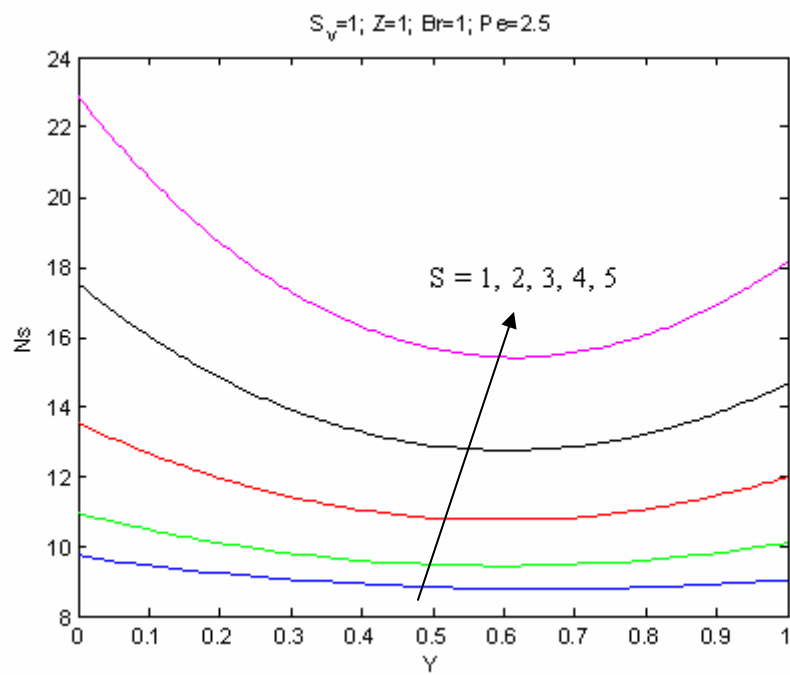


Figure 27. Be Vs Y for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

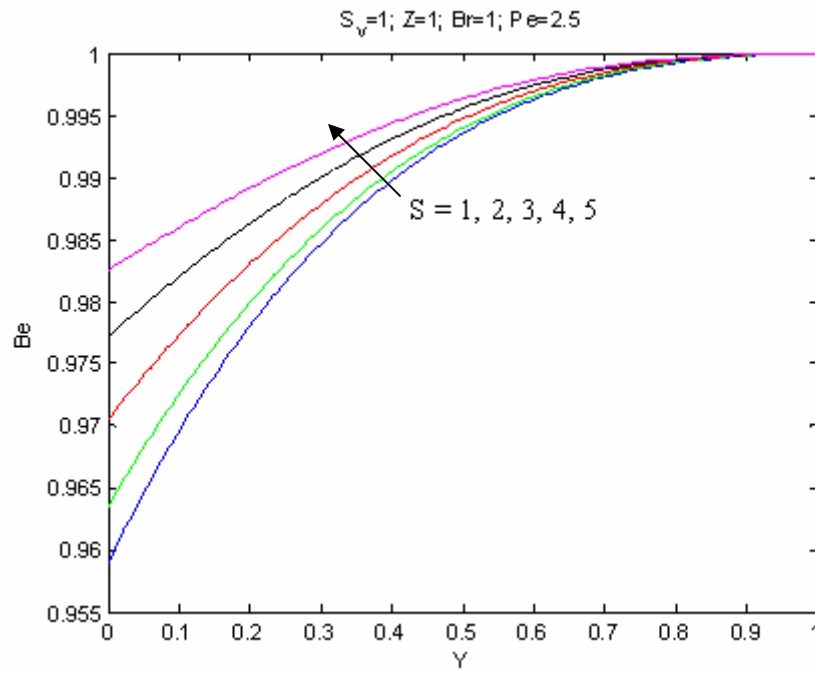


Figure 28. Φ Vs Y for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

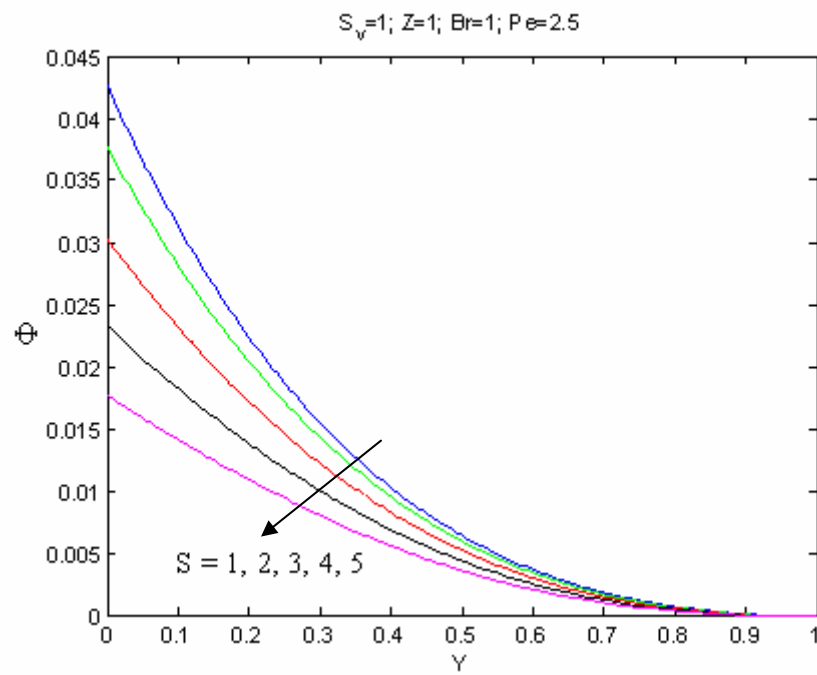


Figure 29. G_f Vs Y for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

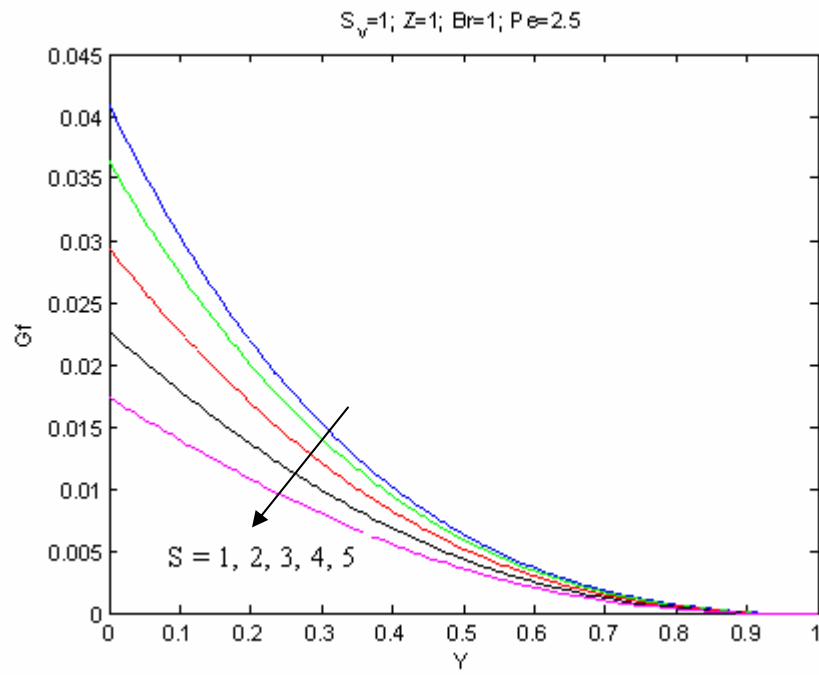


Figure 30. G_h Vs Y for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

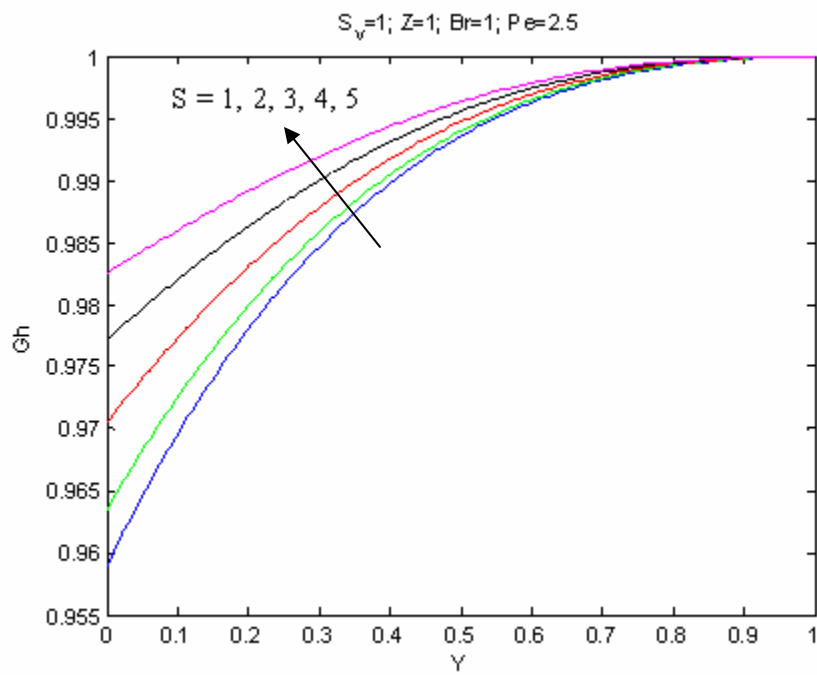


Figure 31. Nh Vs Y for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

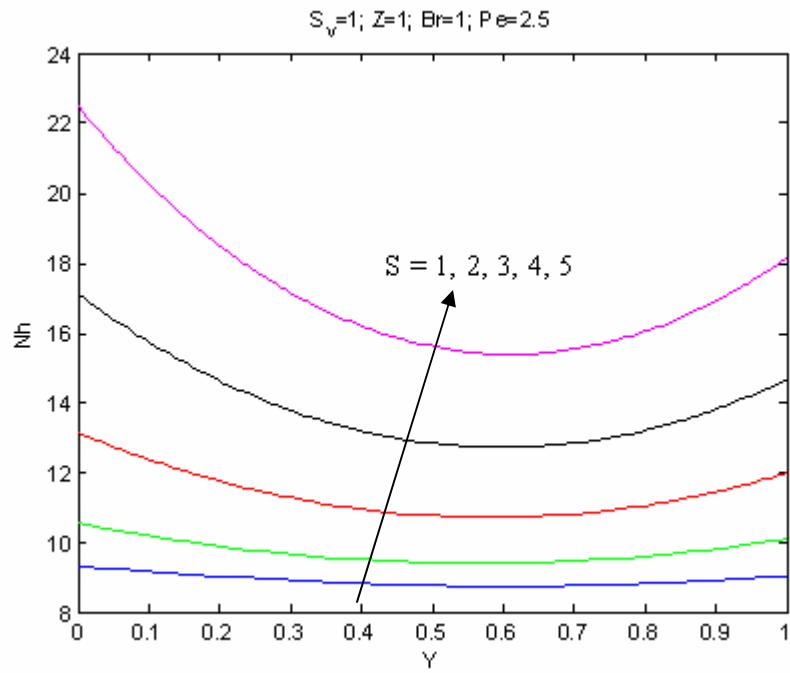


Figure 32. Nh Vs Nf for $S_v=1$; $Z=1$; $Br=1$; $Pe=2.5$ and $S=1, 2, 3, 4$ & 5

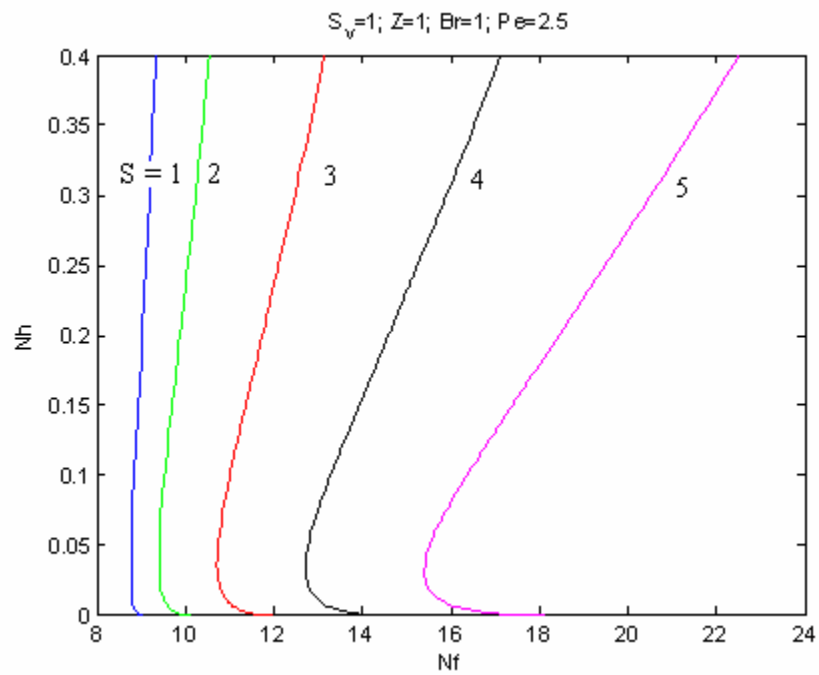


Figure 33. Ns Vs Y for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5

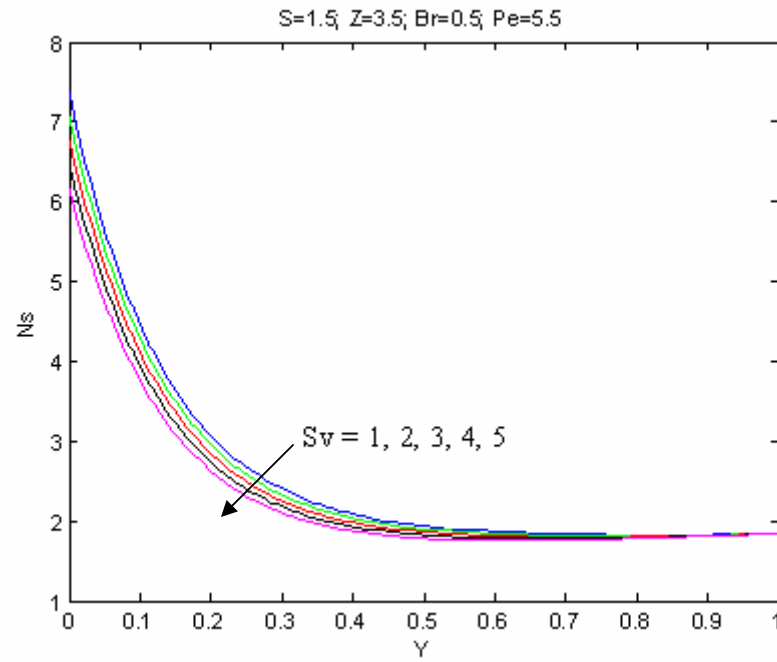


Figure 34. Be Vs Y for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5

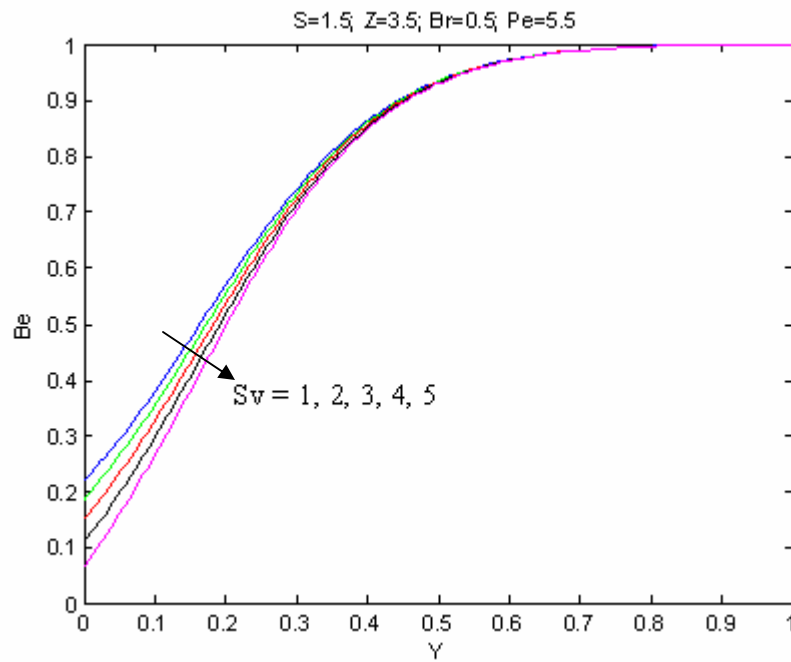


Figure 35. Φ Vs Y for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5

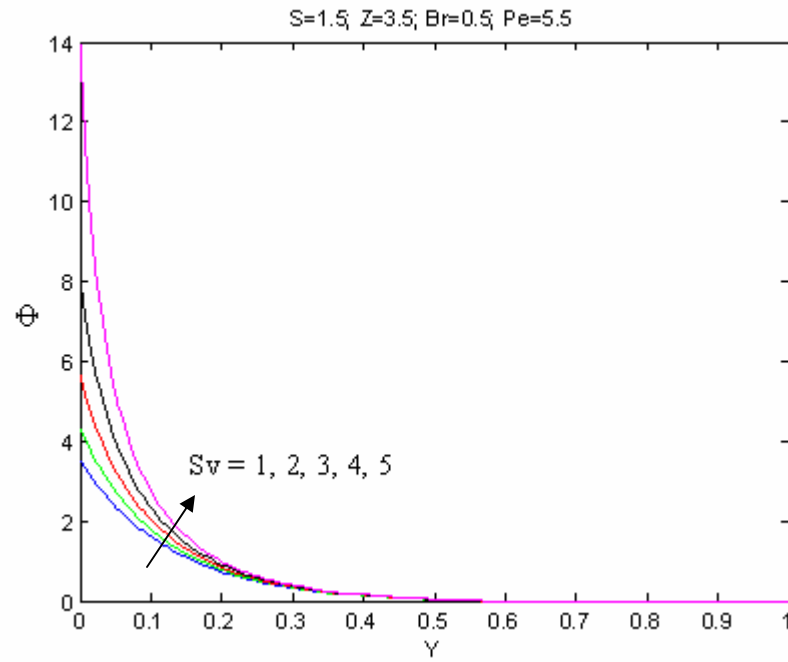


Figure 36. Gf Vs Y for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5

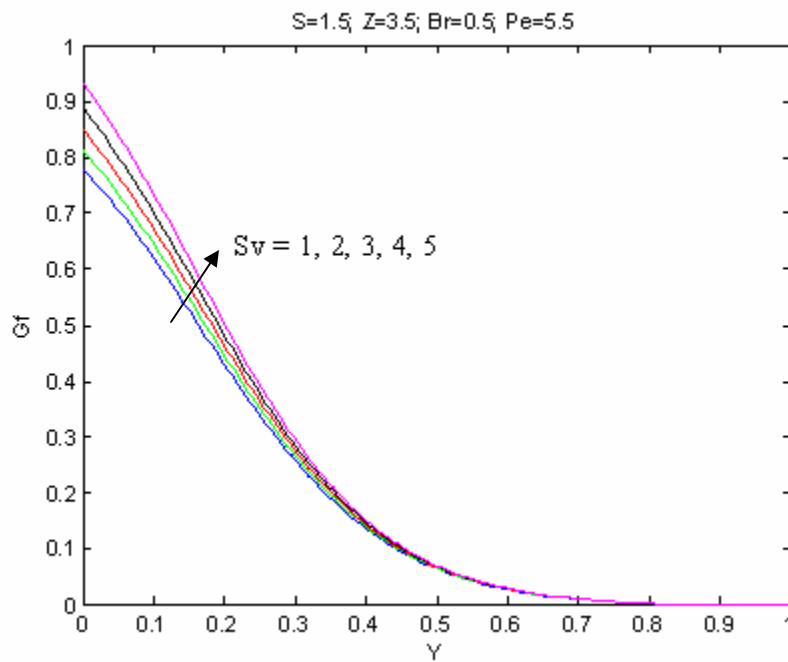


Figure 37. Gh Vs Y for S=1.5; Z=3.5; Br=0.5; Pe=5.5 and Sv=1, 2, 3, 4 & 5

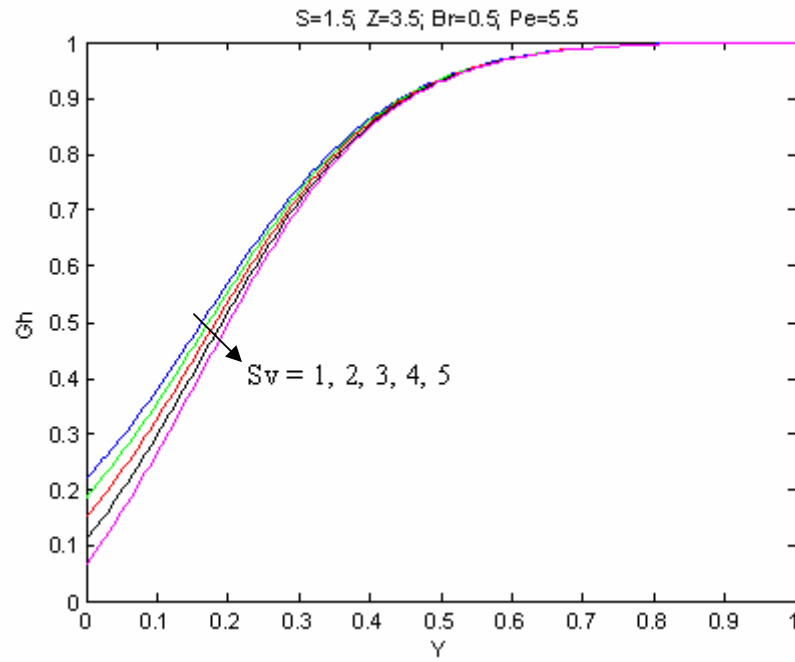


Figure 38. Nf Vs Y for S=1.5; Z=3.5; Br=0.5; Pe=5.5 and Sv=1, 2, 3, 4 & 5

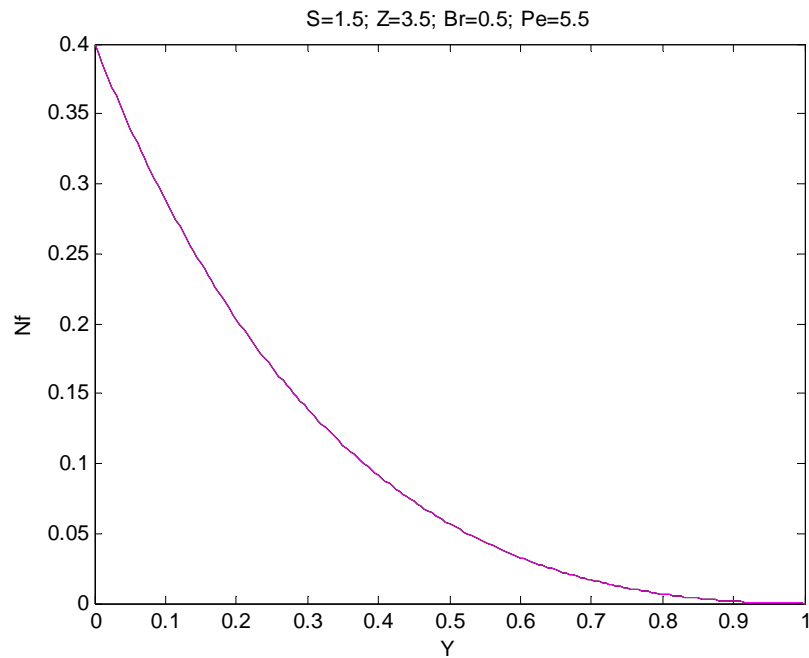


Figure 39. Nh Vs Y for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5

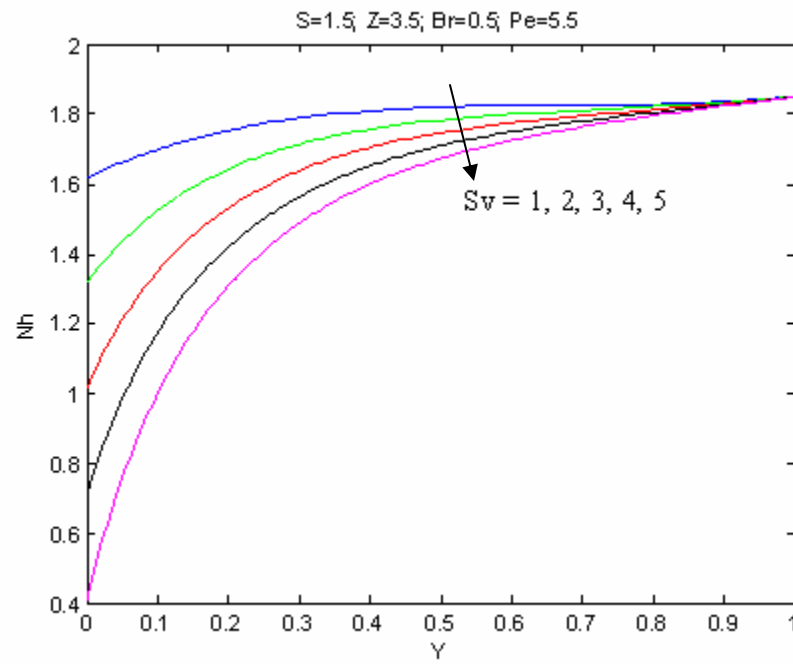
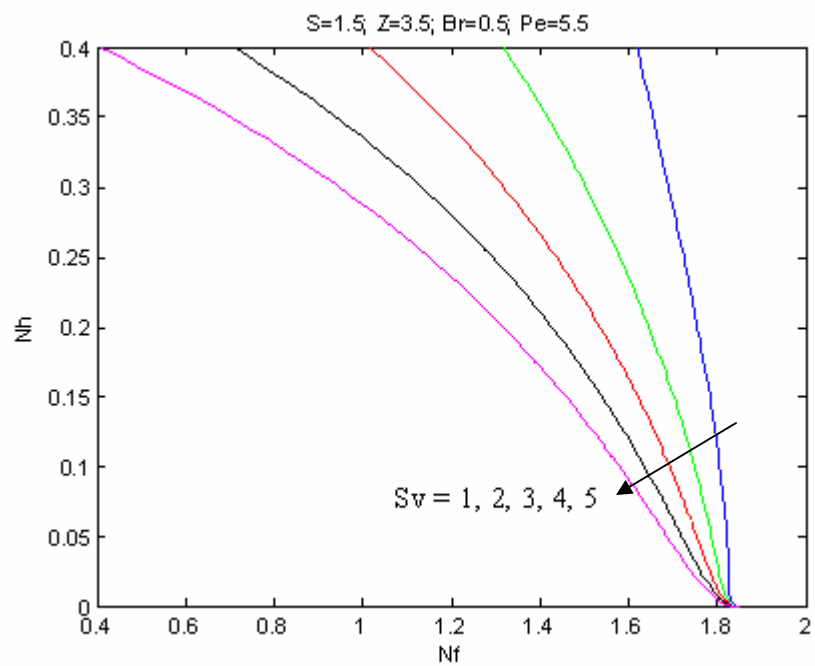


Figure 40. Nh Vs Nf for $S=1.5$; $Z=3.5$; $Br=0.5$; $Pe=5.5$ and $Sv=1, 2, 3, 4$ & 5



**FIGURES FOR
CIRCULAR MICROTUBE**

Figure 41. Ns Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

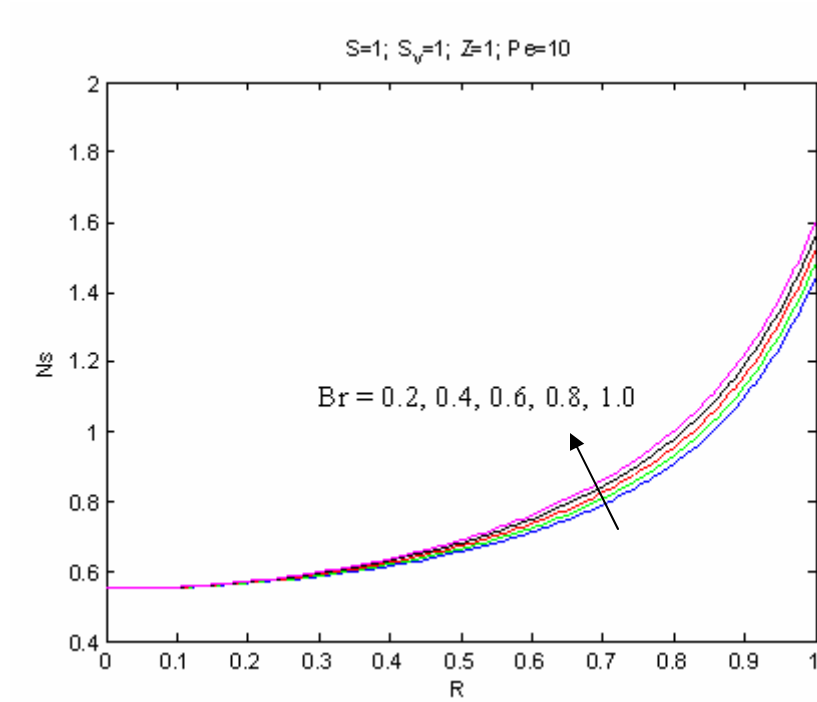


Figure 42. Be Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

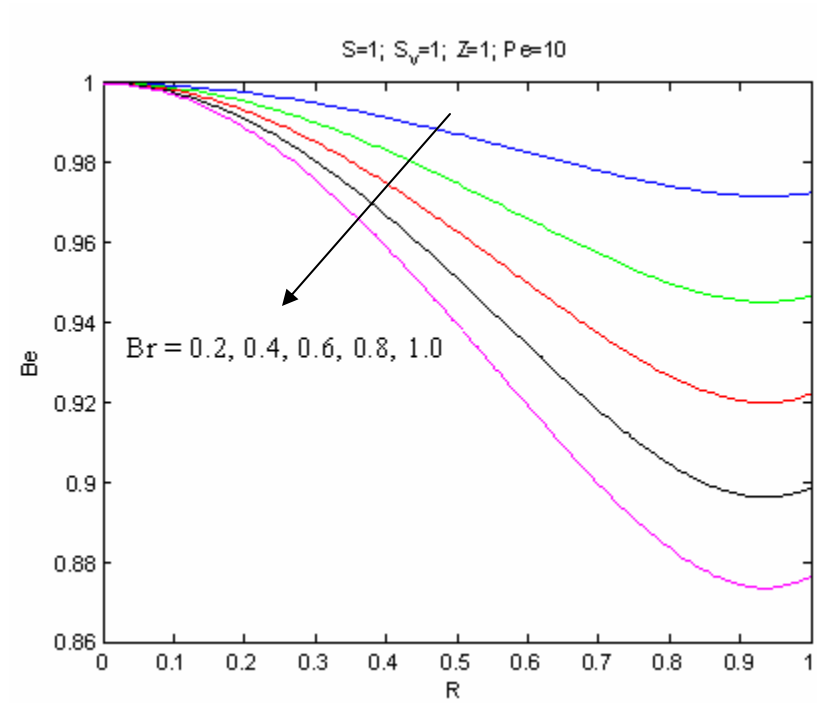


Figure 43. Φ Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

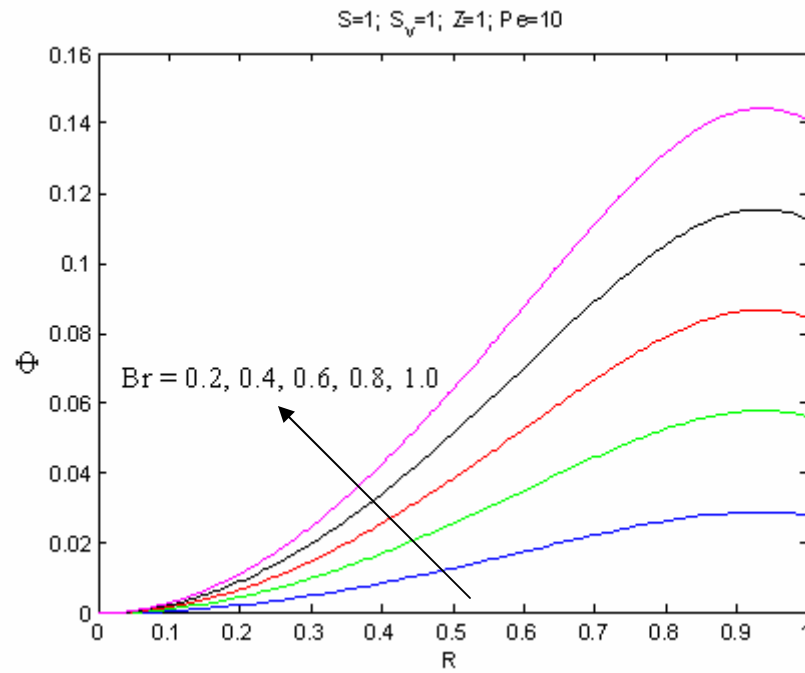


Figure 44. G_f Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

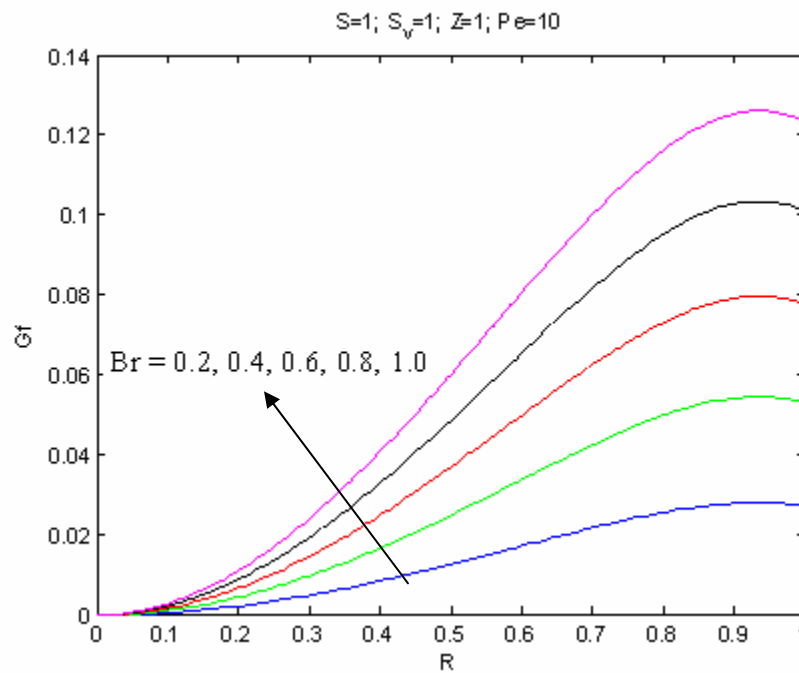


Figure 45. Gr Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

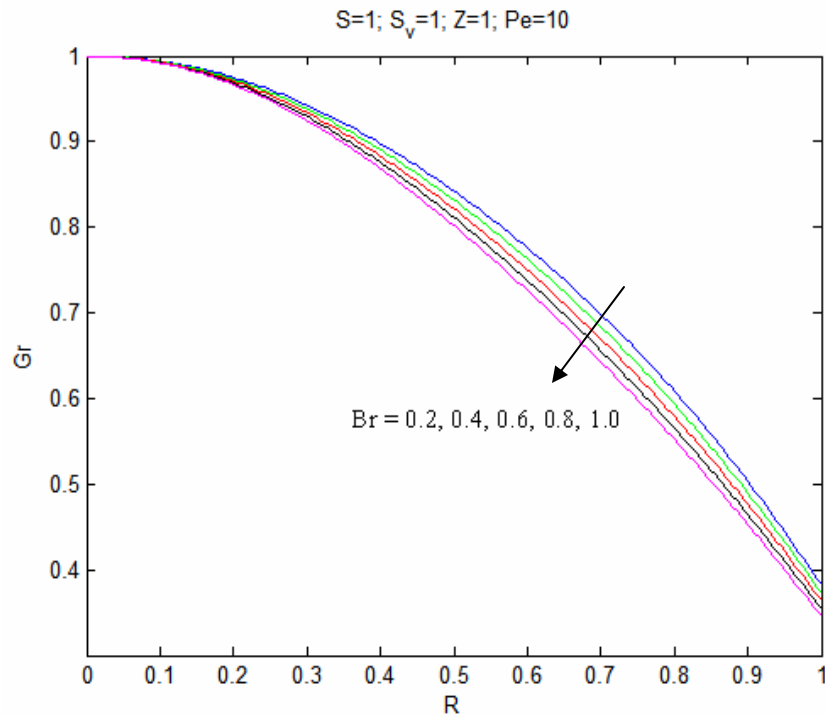


Figure 46. Nf Vs R for $S=1$; $S_v=1$; $Z=1$; $Pe=10$ and $Br=0.2, 0.4, 0.6, 0.8$ & 1.0

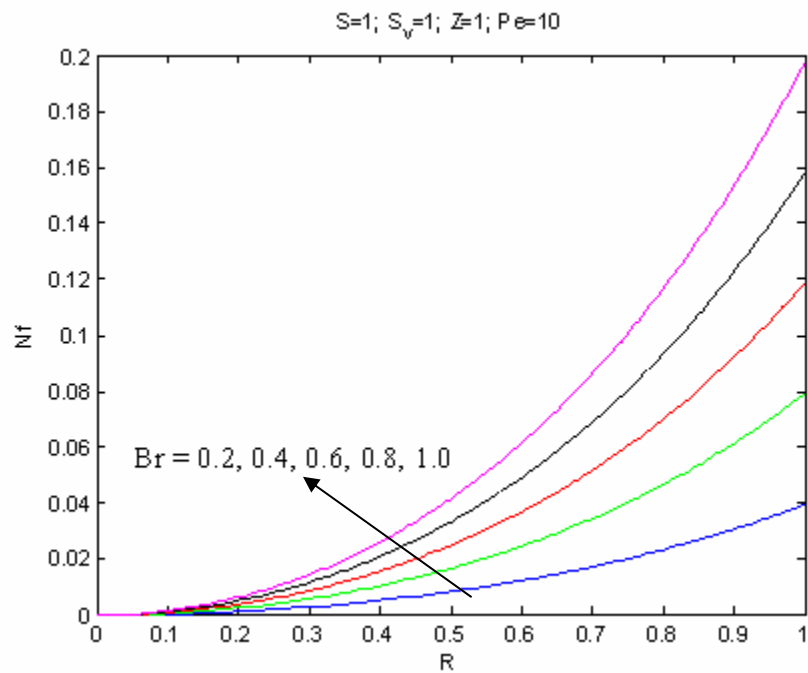


Figure 47. Ns Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

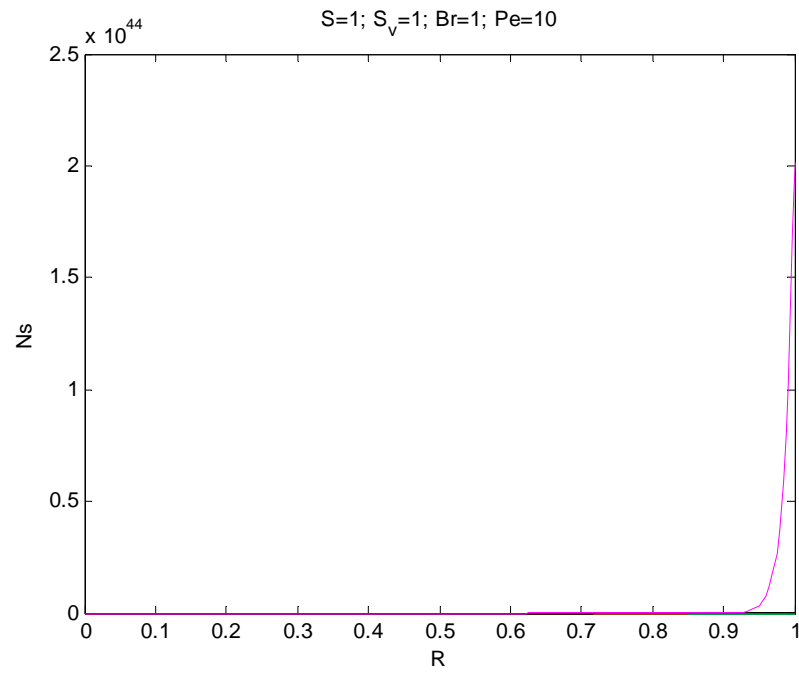


Figure 48. Be Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

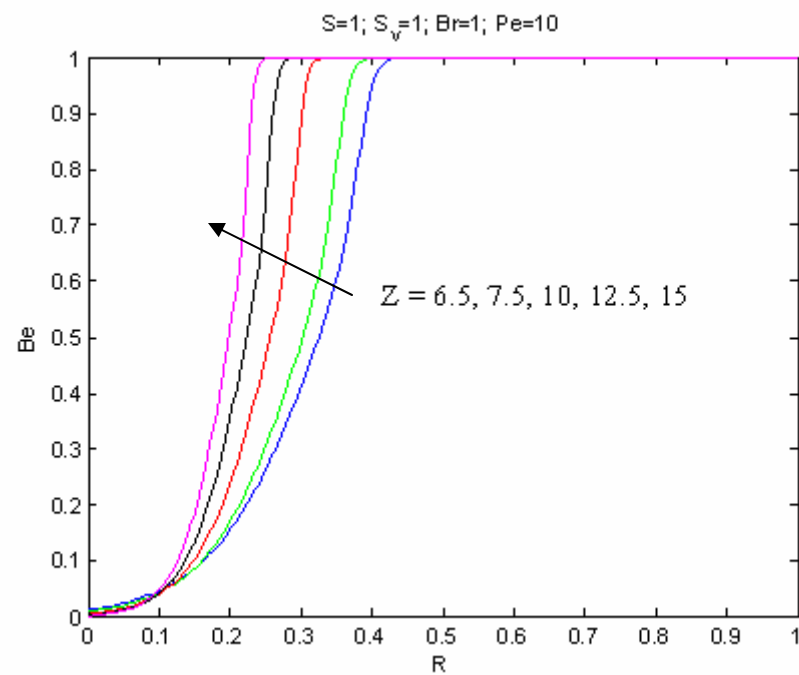


Figure 49. Φ Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

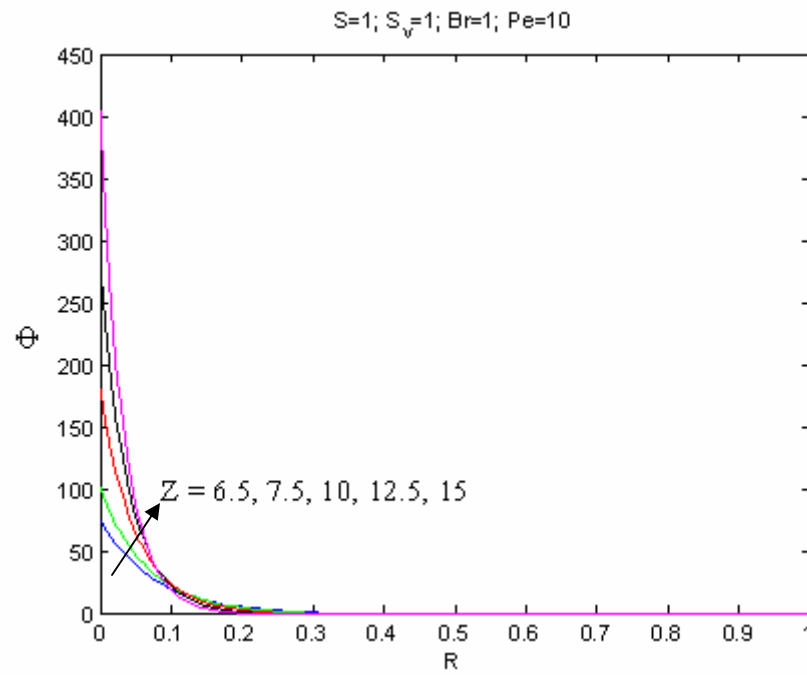


Figure 50. Gf Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

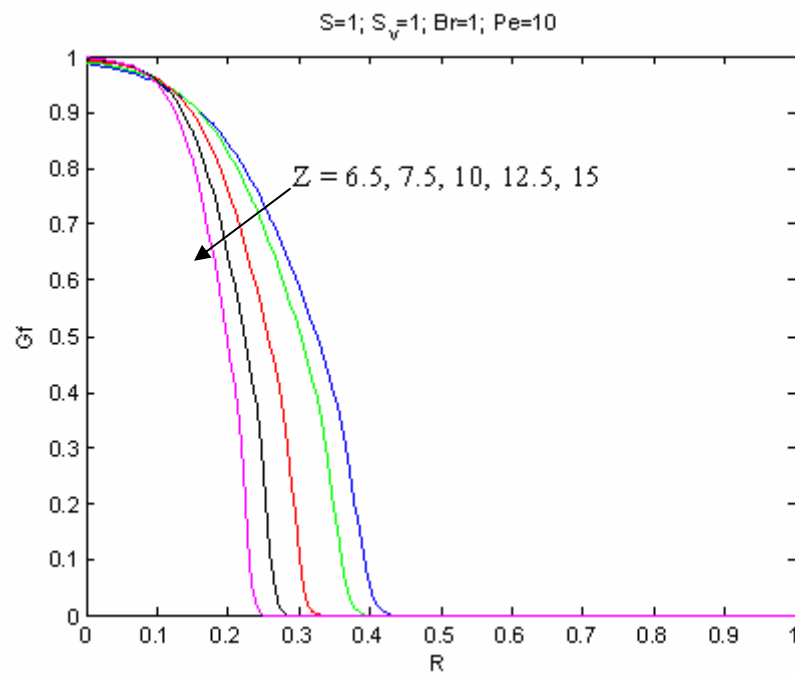


Figure 51. Gr Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

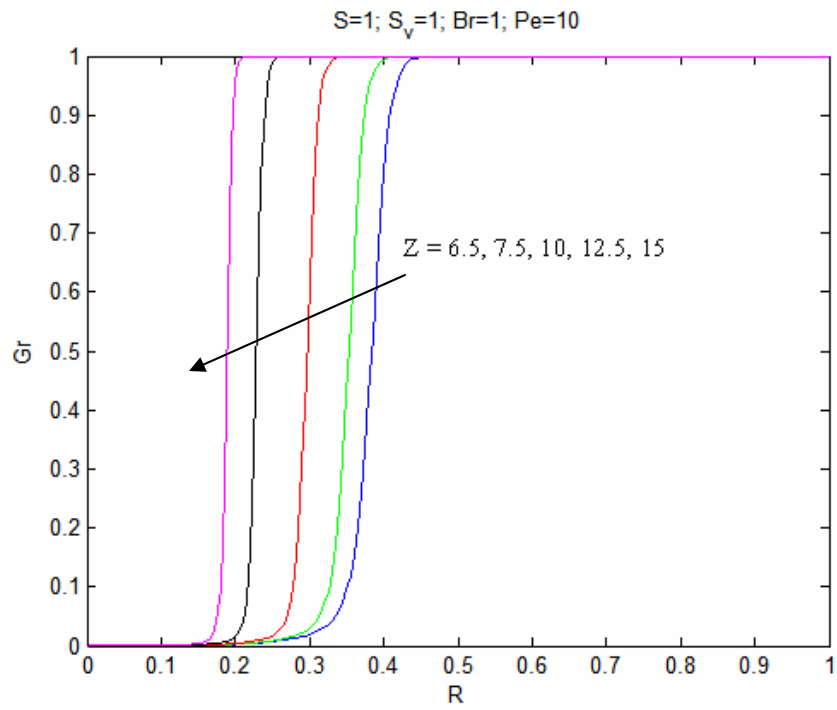


Figure 52. Nf Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

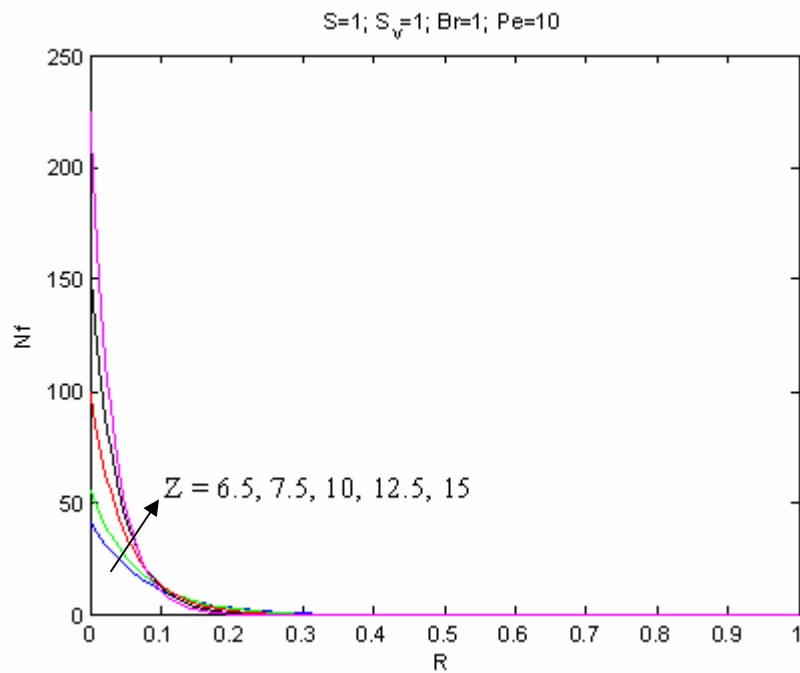


Figure 53. Nh Vs R for $S=1$; $S_v=1$; $Br=1$; $Pe=10$ and $Z=6.5, 7.5, 10, 12.5$ & 15

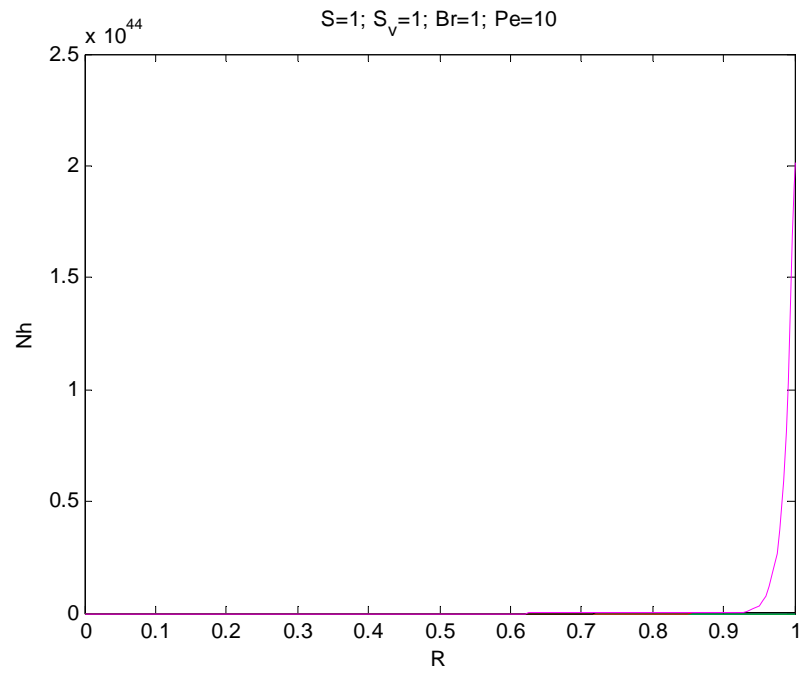


Figure 54. Ns Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

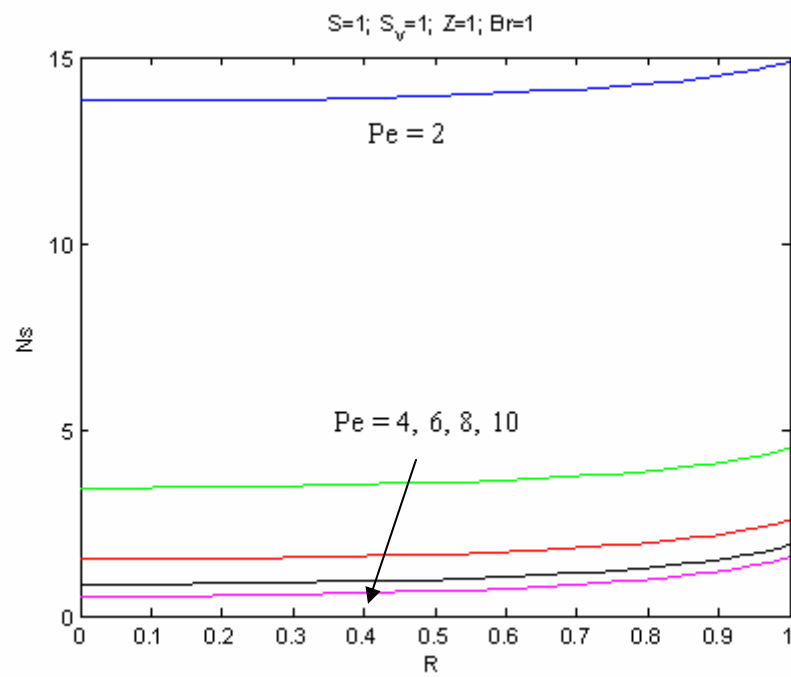


Figure 55. Be Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

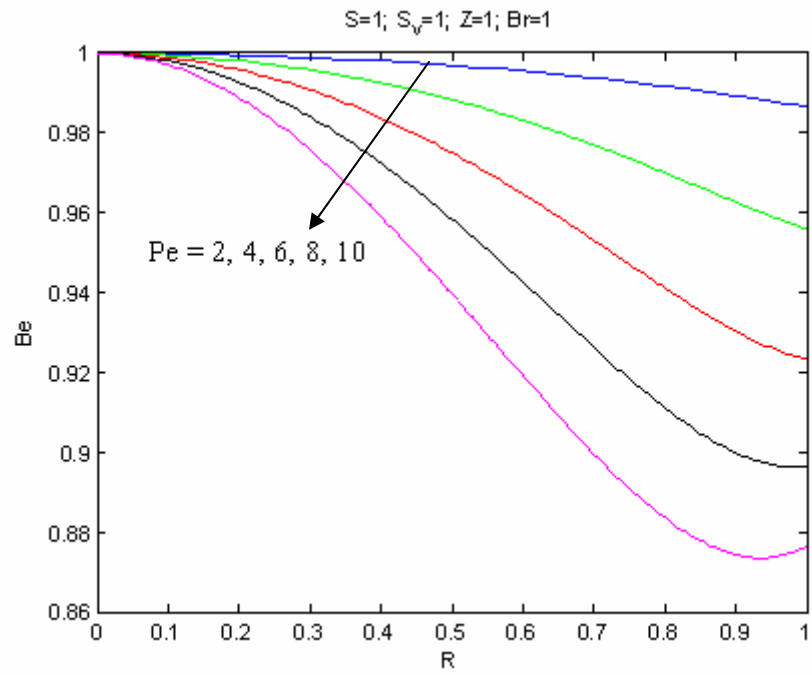


Figure 56. Φ Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

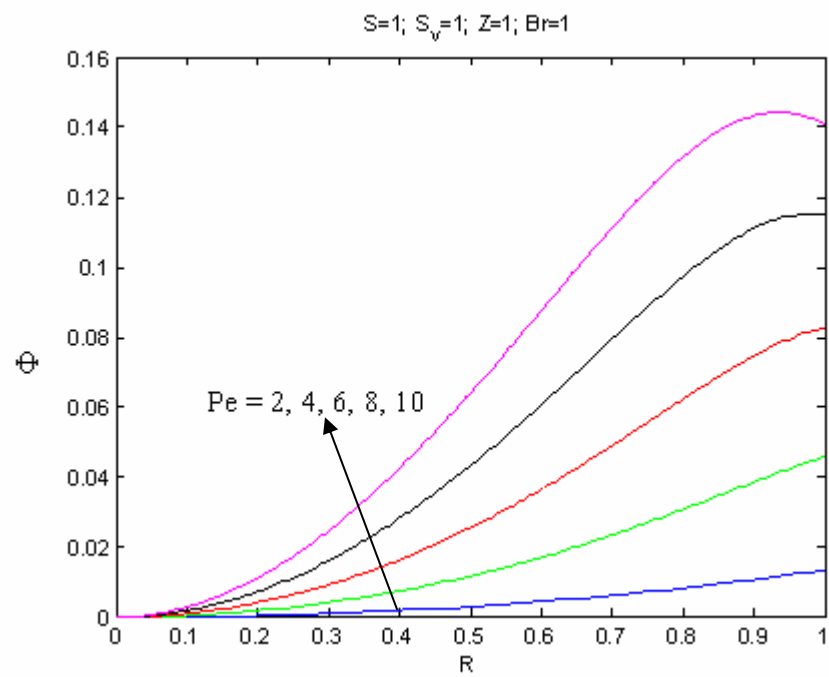


Figure 57. Gf Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

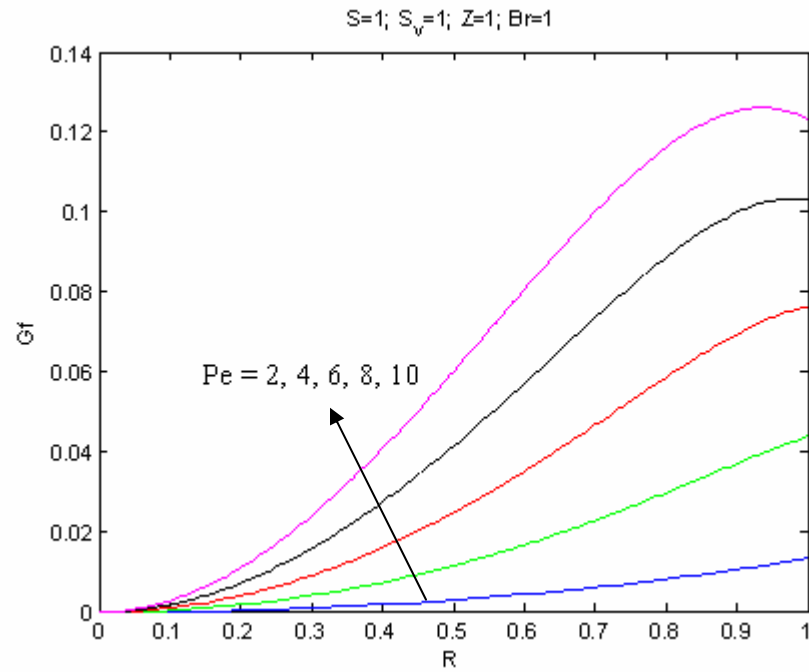


Figure 58. Gr Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

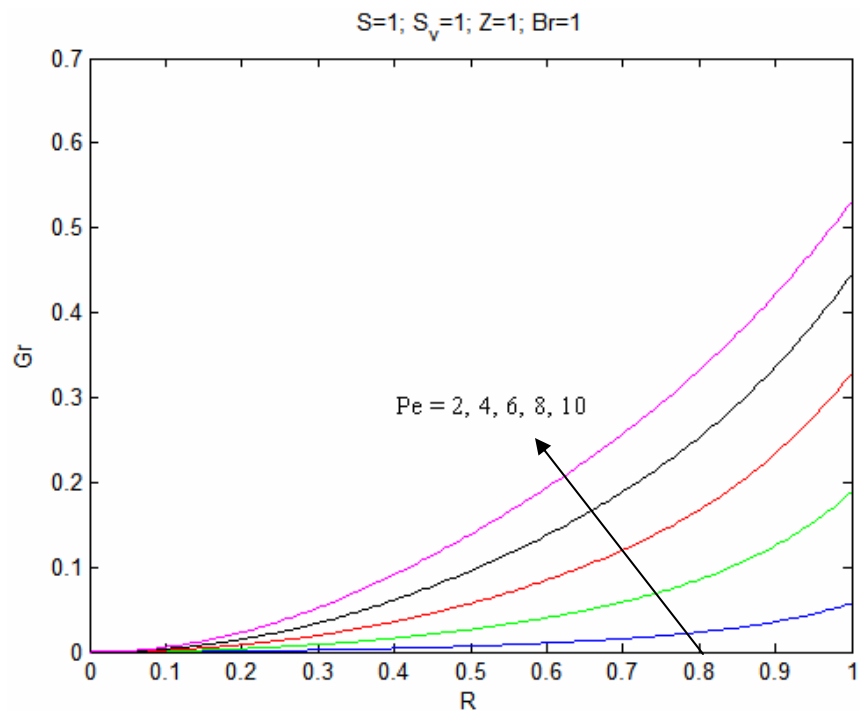


Figure 59. N_c Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

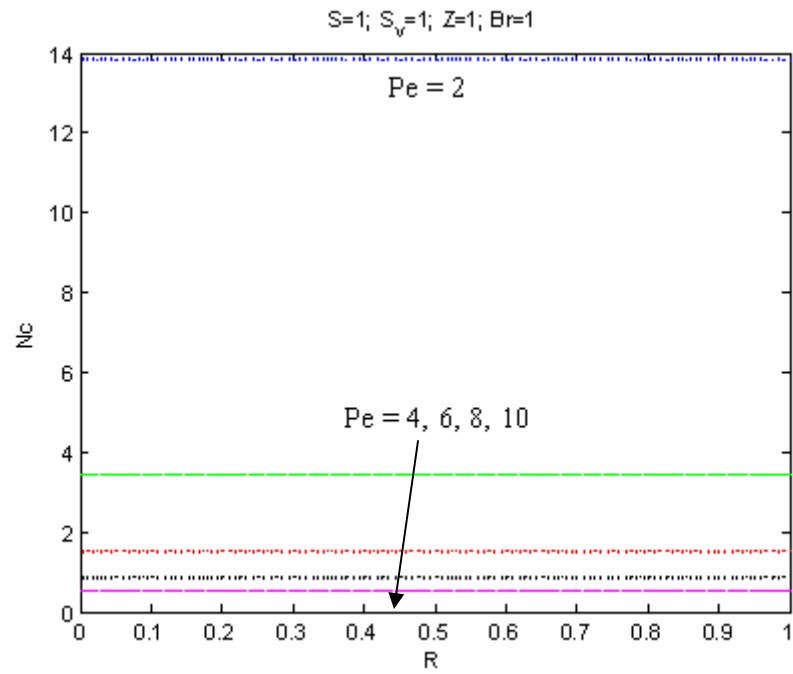


Figure 60. N_h Vs R for $S=1$; $S_v=1$; $Z=1$; $Br=1$ and $Pe=2, 4, 6, 8$ & 10

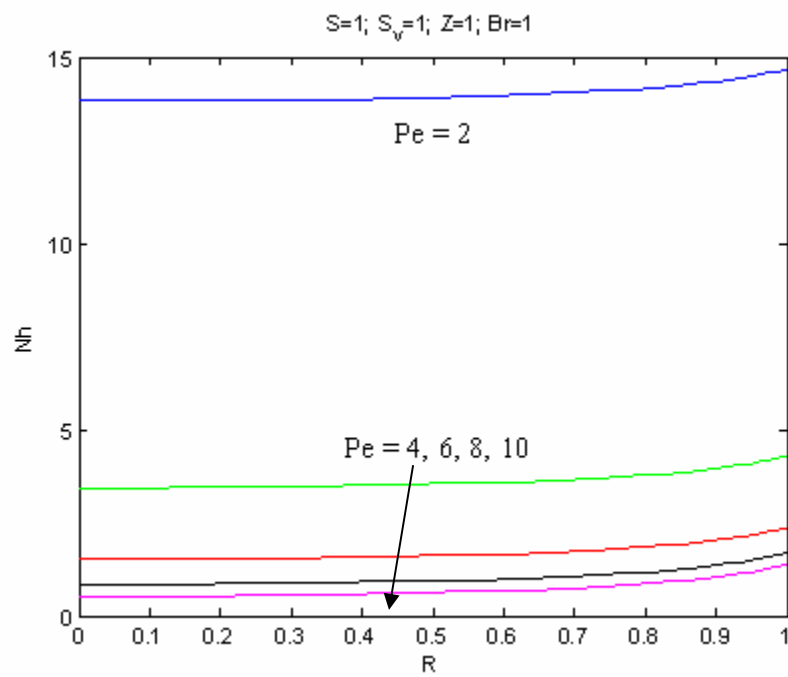


Figure 61. Ns Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

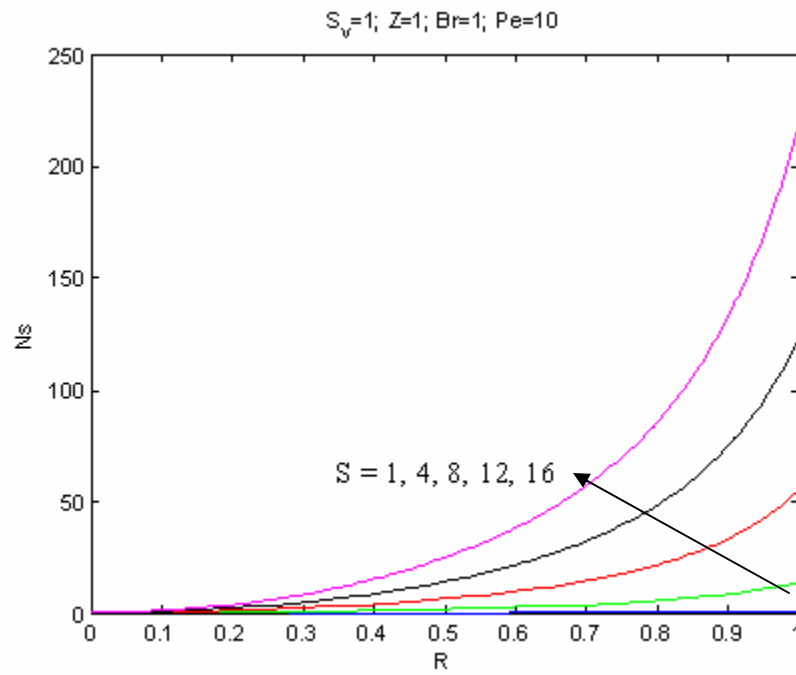


Figure 62. Be Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

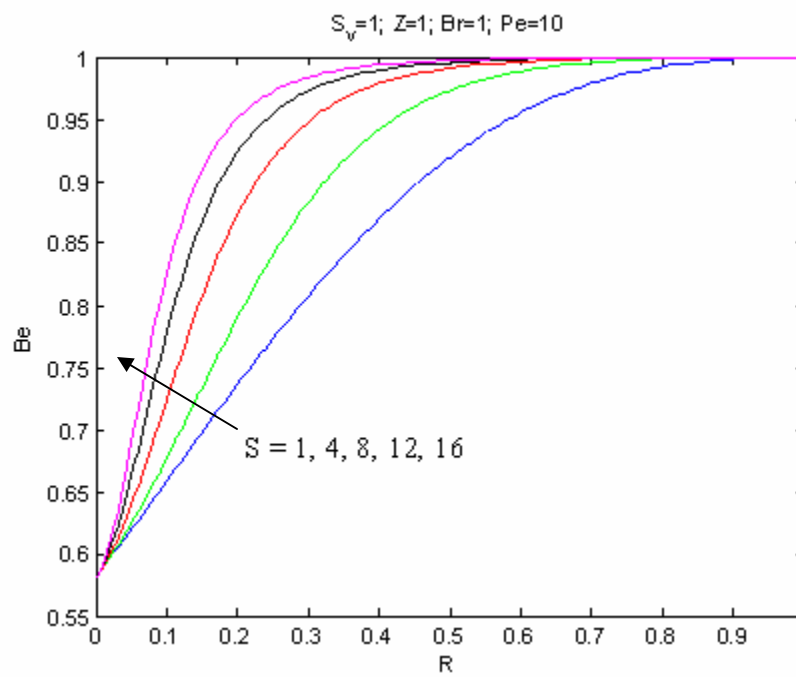


Figure 63. Φ Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

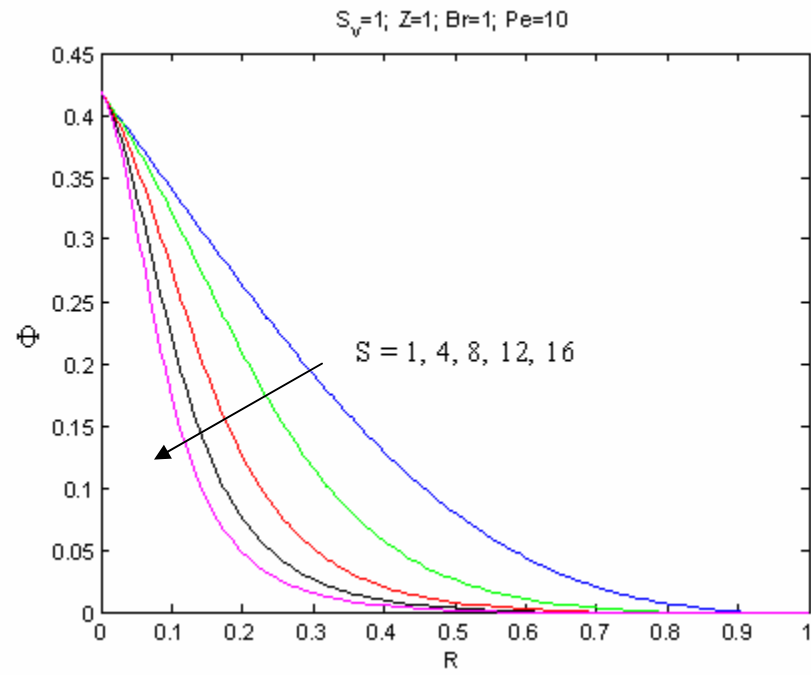


Figure 64. G_f Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

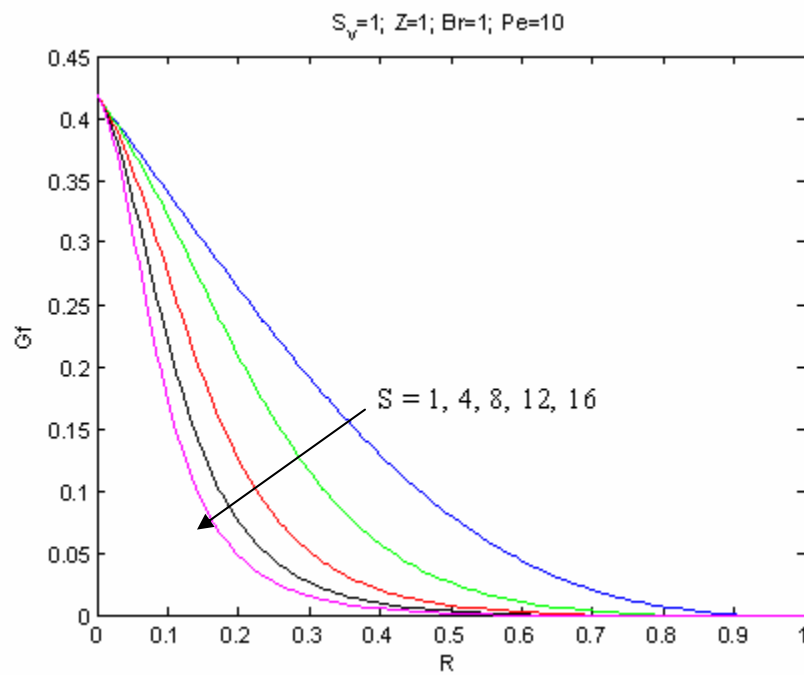


Figure 65. Gr Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

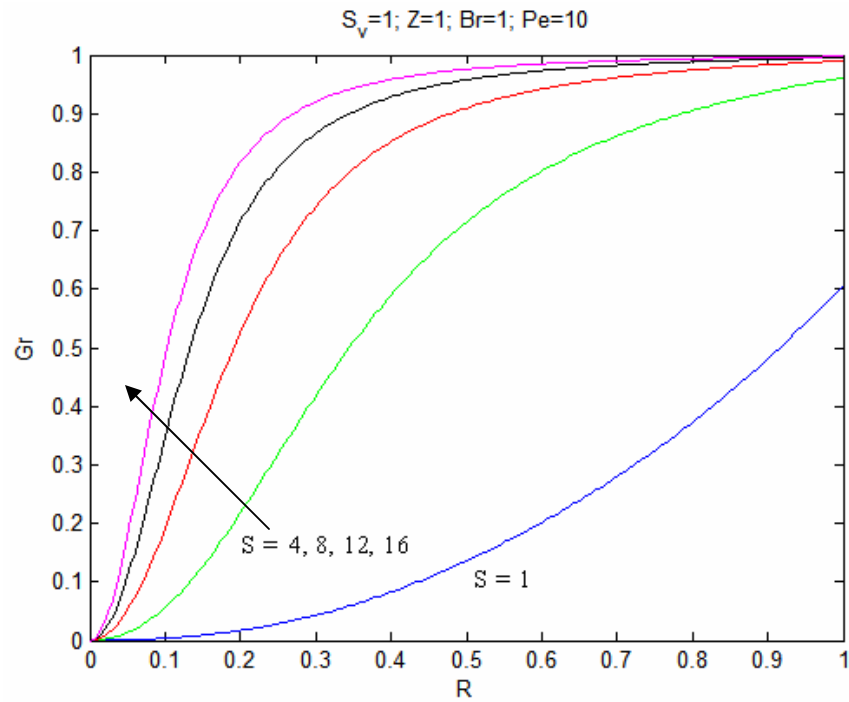


Figure 66. Nf Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

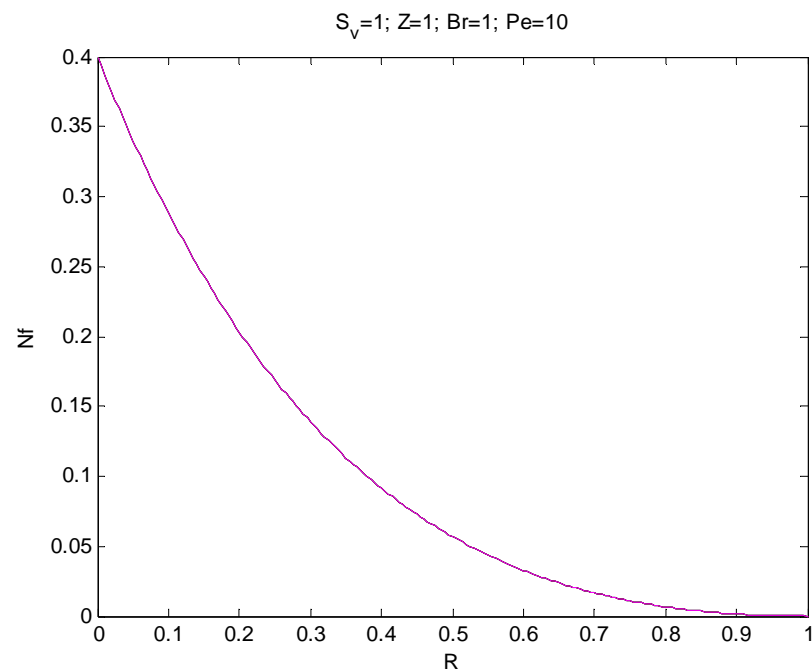


Figure 67. Nh Vs R for $S_v=1$; $Z=1$; $Br=1$; $Pe=10$ and $S=1, 4, 8, 12$ & 16

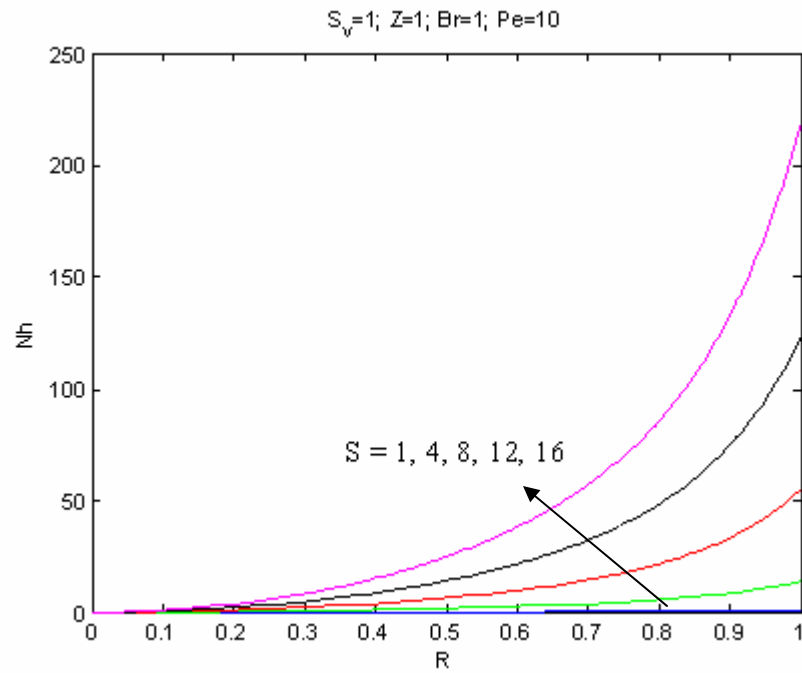


Figure 68. Ns Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $S_v=1, 4, 8, 12$ & 16

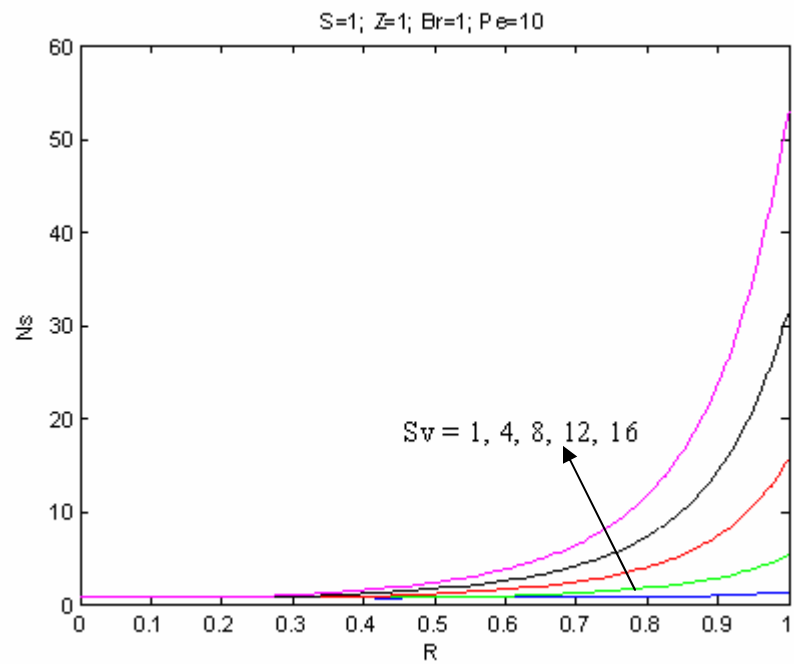


Figure 69. Be Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16

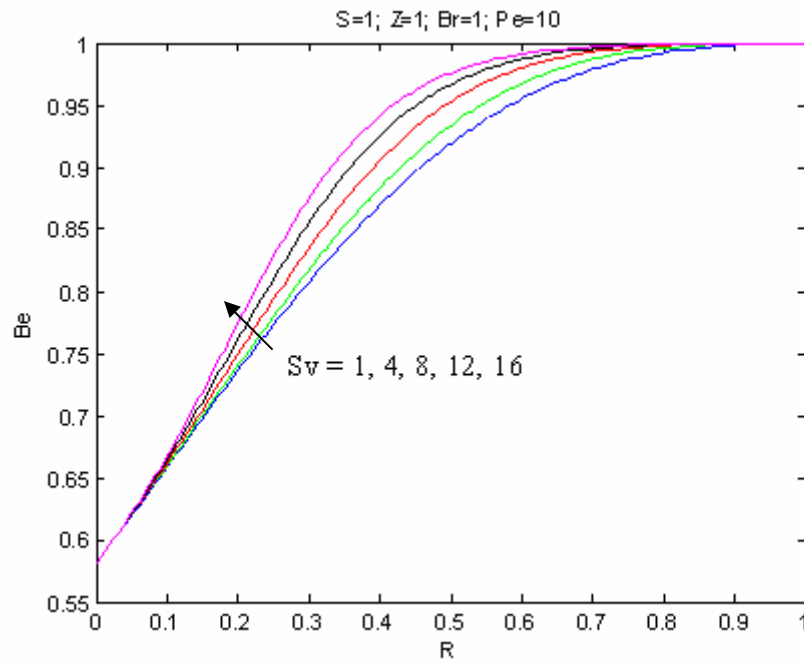


Figure 70. Φ Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16

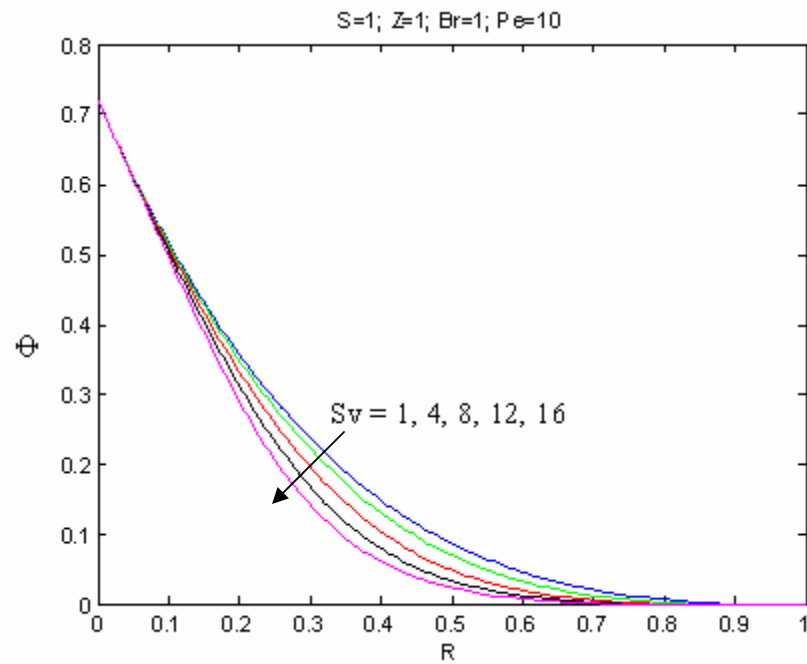


Figure 71. Gf Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16

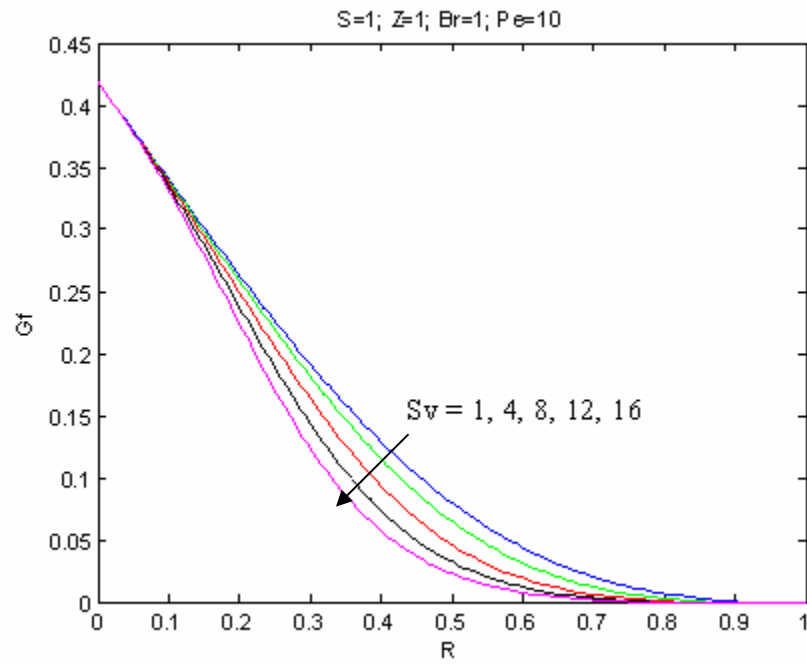


Figure 72. Gr Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16

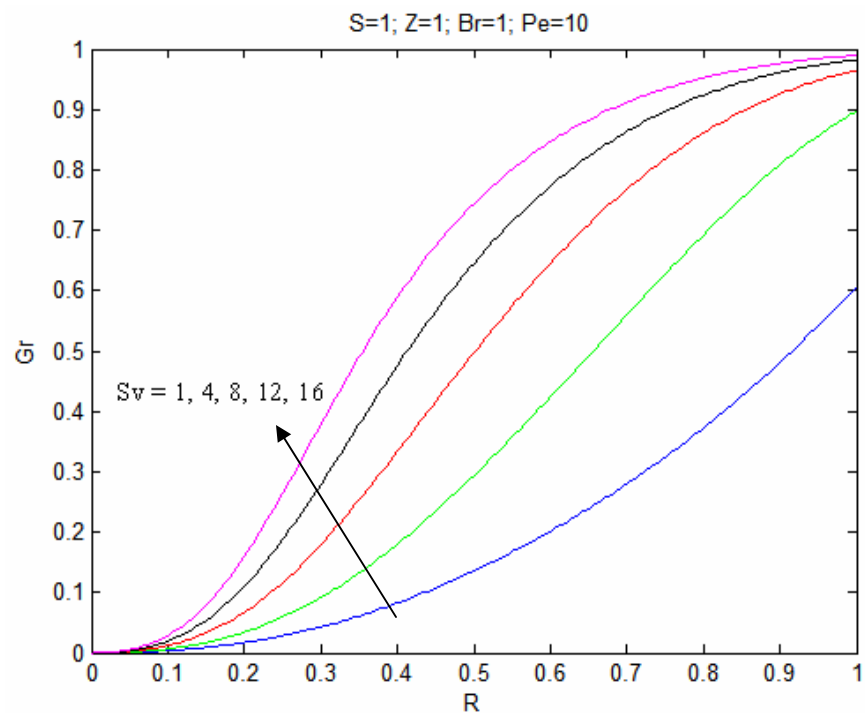


Figure 73. N_f Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16

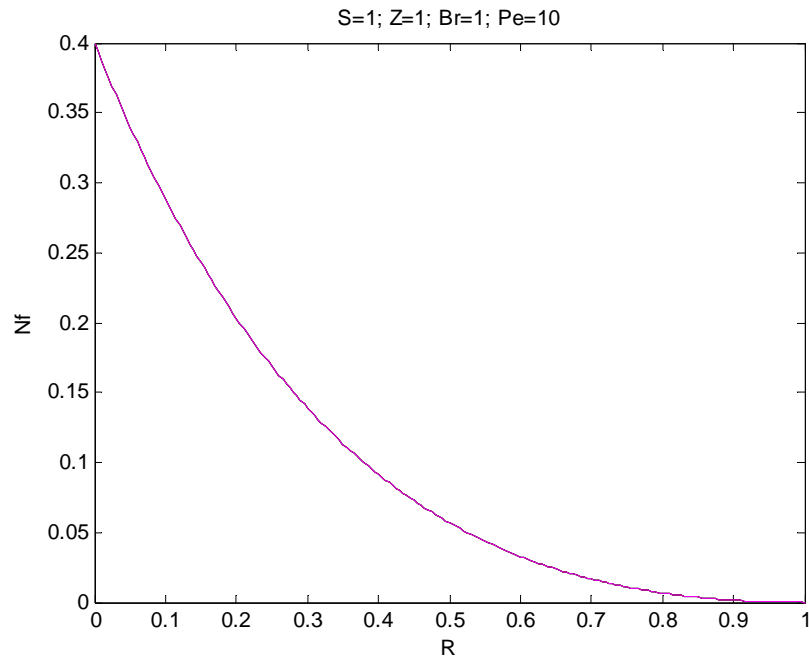
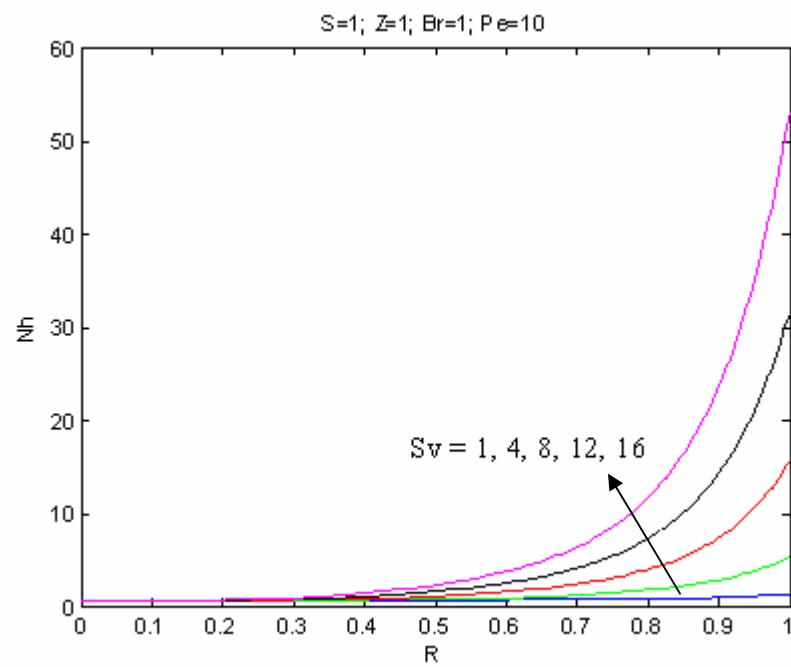


Figure 74. N_h Vs R for $S=1$; $Z=1$; $Br=1$; $Pe=10$ and $Sv=1, 4, 8, 12$ & 16



MATLAB PROGRAMS

1. PROGRAMS FOR PARALLEL PLATE MICROCHANNEL

1.1. Distribution of $N_s, Be, \Phi, G_F, G_H, N_F$ and N_H versus Y for a range of

Br and set of S, S_v, Z & Pe

```

S=1; S_v=1; Z=1; Pe=10;
% S=5; S_v=0.75; Z=7.5; Pe=2;
% % % % S=2; S_v=1; Z=5; Pe=0.5;
% % % % S=10; S_v=25; Z=20; Pe=5;
% % % % S=20; S_v=2; Z=2.5; Pe=1;
% % % % S=25; S_v=15; Z=10; Pe=2.5;

q=1.86;
s=1;
Dh=250*10^-6;
Y=0:0.005:1;

Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];

Ny=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S - S^2/exp(2*Z) + exp(-Z - Y.*Z)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z).*Y.^2 ...
+ (2*S.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z))/Z^2 + (2*S)/(exp(2*Z)*Z^2) + (2*S)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S)/Z^2 + S^2/(exp(2*Z)*Z^2) + S^2/(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(exp(Z)*Z) - 2/(exp(Y.*Z)*Z) + (2*S)/(exp(Z)*Z) - (2*S)/(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...
- (2*S.*Y)/(exp(Z)*Z) + (2*S.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ...
- (S.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S*Z^2)/(2*exp(2*Z)) + (S^2*Z^2)/(4*exp(2*Z)) - (Y.^2*Z^2)/(2*exp(2*Z)) - (S.*Y.^2*Z^2)/exp(2*Z) ...
- (S^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S.*Y.^4*Z^2)/(2*exp(2*Z)) + (S^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S*(S_v))/(2*exp(3*Z)) ...
+ (2*S*(S_v))/exp(2*Z) + (S*(S_v))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S*(S_v))/2 - (5*S^2*(S_v))/exp(3*Z) + (2*S^2*(S_v))/exp(2*Z) - (S^2*(S_v))/(2*exp(Z)) ...
- (exp(-Z - 2.*Y.*Z)*S^2*(S_v))/2 - (2*S.*Y.*(S_v))/exp(2*Z) - (3*S.*Y.*(S_v))/exp(Z) + (3*S^2.*Y.*(S_v))/(2*exp(3*Z)) - (2*S^2.*Y.*(S_v))/exp(2*Z) ...
+ (S^2.*Y.*(S_v))/(2*exp(Z)) + (13*S.*Y.^2*(S_v))/(2*exp(3*Z)) - (4*S.*Y.^2*(S_v))/exp(2*Z) + (3*S.*Y.^2*(S_v))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S.*Y.^2*(S_v))/2 ...
+ (5*S^2.*Y.^2*(S_v))/exp(3*Z) - (2*S^2.*Y.^2*(S_v))/exp(2*Z) + (S^2.*Y.^2*(S_v))/(2*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v))/2 - (3*S.*Y.^3*(S_v))/exp(3*Z) ...
+ (4*S.*Y.^3*(S_v))/exp(2*Z) - (S.*Y.^3*(S_v))/exp(Z) - (3*S^2.*Y.^3*(S_v))/(2*exp(3*Z)) + (2*S^2.*Y.^3*(S_v))/exp(2*Z) - (S^2.*Y.^3*(S_v))/(2*exp(Z)) ...
+ (3*S*(S_v))/(exp(4*Z)*Z^3) - (4*S*(S_v))/(exp(3*Z)*Z^3) + (S*(S_v))/(exp(2*Z)*Z^3) + (S*(S_v))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S*(S_v))/Z^3 ...
- (4*exp(-Z - 2.*Y.*Z)*S*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S*(S_v))/Z^3 + (8*exp(-2*Z - Y.*Z)*S*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S*(S_v))/Z^3 ...
+ (3*S^2*(S_v))/(exp(4*Z)*Z^3) - (4*S^2*(S_v))/(exp(3*Z)*Z^3) + (S^2*(S_v))/(exp(2*Z)*Z^3) + (S^2*(S_v))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S^2*(S_v))/Z^3 ...
- (4*exp(-Z - 2.*Y.*Z)*S^2*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S^2*(S_v))/Z^3 + (8*exp(-2*Z - Y.*Z)*S^2*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S^2*(S_v))/Z^3 ...
+ (11*S*(S_v))/(exp(3*Z)*Z^2) - (8*S*(S_v))/(exp(2*Z)*Z^2) + (2*S*(S_v))/(exp(Z)*Z^2) - (S*(S_v))/(exp(3.*Y.*Z)*Z^2) - (2*S*(S_v))/(exp(Y.*Z)*Z^2) ...
- (exp(-Z - 2.*Y.*Z)*S*(S_v))/Z^2 - (9*exp(-2*Z - Y.*Z)*S*(S_v))/Z^2 + (8*exp(-Z - Y.*Z)*S*(S_v))/Z^2 + (8*S^2*(S_v))/(exp(3*Z)*Z^2); ...

```

$$\begin{aligned}
& - (4*S^2*(S_v))/(exp(2*Z)*Z^2) + (S^2*(S_v))/(exp(Z)*Z^2) - (S^2*(S_v))/(exp(3.*Y.*Z)*Z^2) - \\
& (S^2*(S_v))/(exp(Y.*Z)*Z^2) - (exp(-Z - 2.*Y.*Z)*S^2*(S_v))/Z^2 ... \\
& - (6*exp(-2*Z - Y.*Z)*S^2*(S_v))/Z^2 + (4*exp(-Z - Y.*Z)*S^2*(S_v))/Z^2 - \\
& (6*S.*Y.*(S_v))/(exp(3*Z)*Z^2) + (8*S.*Y.*(S_v))/(exp(2*Z)*Z^2) ... \\
& - (2*S.*Y.*(S_v))/(exp(Z)*Z^2) + (2*S.*Y.*(S_v))/(exp(Y.*Z)*Z^2) + (6*exp(-2*Z - \\
& Y.*Z)*S.*Y.*(S_v))/Z^2 - (8*exp(-Z - Y.*Z)*S.*Y.*(S_v))/Z^2 ... \\
& - (3*S^2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (4*S^2.*Y.*(S_v))/(exp(2*Z)*Z^2) - \\
& (S^2.*Y.*(S_v))/(exp(Z)*Z^2) + (S^2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) ... \\
& + (3*exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v))/Z^2 - (4*exp(-Z - Y.*Z)*S^2.*Y.*(S_v))/Z^2 + (S*(S_v))/Z + \\
& (2*S*(S_v))/(exp(3*Z)*Z) + (9*S*(S_v))/(exp(2*Z)*Z) ... \\
& - (4*S*(S_v))/(exp(Z)*Z) + (S*(S_v))/(exp(2.*Y.*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S*(S_v))/Z + (exp(-Z - \\
& Y.*Z)*S*(S_v))/Z + (2*S^2*(S_v))/(exp(3*Z)*Z) ... \\
& + (S^2*(S_v))/(exp(2*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S^2*(S_v))/Z - (exp(-Z - Y.*Z)*S^2*(S_v))/Z - \\
& (2*S.*Y.*(S_v))/Z - (13*S.*Y.*(S_v))/(exp(2*Z)*Z) ... \\
& + (8*S.*Y.*(S_v))/(exp(Z)*Z) - (S.*Y.*(S_v))/(exp(2.*Y.*Z)*Z) - (2*S^2.*Y.*(S_v))/(exp(2*Z)*Z) + \\
& (2*exp(-Z - Y.*Z)*S^2.*Y.*(S_v))/Z + (S.*Y.^2*(S_v))/Z ... \\
& + (3*S.*Y.^2*(S_v))/(exp(4*Z)*Z) - (4*S.*Y.^2*(S_v))/(exp(3*Z)*Z) + \\
& (4*S.*Y.^2*(S_v))/(exp(2*Z)*Z) - (4*S.*Y.^2*(S_v))/(exp(Z)*Z) ... \\
& - (3*exp(-3*Z - Y.*Z)*S.*Y.^2*(S_v))/Z + (4*exp(-2*Z - Y.*Z)*S.*Y.^2*(S_v))/Z - (exp(-Z - \\
& Y.*Z)*S.*Y.^2*(S_v))/Z + (3*S^2.*Y.^2*(S_v))/(exp(4*Z)*Z) ... \\
& - (4*S^2.*Y.^2*(S_v))/(exp(3*Z)*Z) + (S^2.*Y.^2*(S_v))/(exp(2*Z)*Z) - (3*exp(-3*Z - \\
& Y.*Z)*S^2.*Y.^2*(S_v))/Z + (4*exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v))/Z ... \\
& - (exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v))/Z - (3*S^2*(S_v))/(4*exp(4*Z)) - (7*S^2*(S_v))/(4*exp(2*Z)) - \\
& (3*S^2*(S_v))/(4*exp(4*Z)) - (3*S^2*(S_v))/(4*exp(2*Z)) ... \\
& + (2*S.*Y.*Z*(S_v))/exp(2*Z) + (S^2.*Y.*Z*(S_v))/exp(2*Z) + (S.*Y.^2*(S_v))/exp(3*Z) + \\
& (3*S.*Y.^2*(S_v))/(2*exp(2*Z)) + (S^2.*Y.^2*(S_v))/exp(3*Z) ... \\
& + (S^2.*Y.^2*(S_v))/(2*exp(2*Z)) - (2*S.*Y.^3*(S_v))/exp(2*Z) - \\
& (S^2.*Y.^3*(S_v))/exp(2*Z) + (3*S.*Y.^4*(S_v))/(4*exp(4*Z)) - (S.*Y.^4*(S_v))/exp(3*Z) ... \\
& + (S.*Y.^4*(S_v))/(4*exp(2*Z)) + (3*S^2.*Y.^4*(S_v))/(4*exp(4*Z)) - \\
& (S^2.*Y.^4*(S_v))/exp(3*Z) + (S^2.*Y.^4*(S_v))/(4*exp(2*Z)) + (S^2*(S_v))/(2*exp(3*Z)) ... \\
& + (S^2*(S_v))/(2*exp(3*Z)) - (S.*Y.^2*(S_v))/exp(3*Z) - (S^2.*Y.^2*(S_v))/exp(3*Z) \\
& + (S.*Y.^4*(S_v))/(2*exp(3*Z)) ... \\
& + (S^2.*Y.^4*(S_v))/(2*exp(3*Z)) + (9*S^2*(S_v)^2)/(16*exp(6*Z)) - \\
& (23*S^2*(S_v)^2)/(8*exp(4*Z)) + (2*S^2*(S_v)^2)/exp(3*Z) + (S^2*(S_v)^2)/(16*exp(2*Z)) ... \\
& - (exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/2 - exp(-3*Z - Y.*Z)*S^2*(S_v)^2 - \\
& (2*S^2.*Y.*(S_v)^2)/exp(3*Z) - (S^2.*Y.*(S_v)^2)/exp(2*Z) + (9*S^2.*Y.^2*(S_v)^2)/(8*exp(6*Z)) ... \\
& - (3*S^2.*Y.^2*(S_v)^2)/(2*exp(5*Z)) + (11*S^2.*Y.^2*(S_v)^2)/(2*exp(4*Z)) - \\
& (7*S^2.*Y.^2*(S_v)^2)/(2*exp(3*Z)) + (15*S^2.*Y.^2*(S_v)^2)/(8*exp(2*Z)) ... \\
& + (exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/2 - exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2 - \\
& (3*S^2.*Y.^3*(S_v)^2)/exp(4*Z) + (4*S^2.*Y.^3*(S_v)^2)/exp(3*Z) ... \\
& - (S^2.*Y.^3*(S_v)^2)/exp(2*Z) + (9*S^2.*Y.^4*(S_v)^2)/(16*exp(6*Z)) - \\
& (3*S^2.*Y.^4*(S_v)^2)/(2*exp(5*Z)) + (11*S^2.*Y.^4*(S_v)^2)/(8*exp(4*Z)) ... \\
& - (S^2.*Y.^4*(S_v)^2)/(2*exp(3*Z)) + (S^2.*Y.^4*(S_v)^2)/(16*exp(2*Z)) + \\
& (9*S^2*(S_v)^2)/(4*exp(6*Z)*Z^4) - (6*S^2*(S_v)^2)/(exp(5*Z)*Z^4) ... \\
& + (11*S^2*(S_v)^2)/(2*exp(4*Z)*Z^4) - (2*S^2*(S_v)^2)/(exp(3*Z)*Z^4) + \\
& (S^2*(S_v)^2)/(4*exp(2*Z)*Z^4) + (S^2*(S_v)^2)/(4*exp(2.*Y.*Z)*Z^4) ... \\
& + (9*exp(-4*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z^4) - (6*exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^4 + \\
& (11*exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^4) ... \\
& - (2*exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^4 - (9*exp(-5*Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^4) + (12*exp(- \\
& 4*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 - (11*exp(-3*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 ... \\
& + (4*exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 - (exp(-Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^4) + \\
& (12*S^2*(S_v)^2)/(exp(5*Z)*Z^3) - (22*S^2*(S_v)^2)/(exp(4*Z)*Z^3) ... \\
& + (27*S^2*(S_v)^2)/(2*exp(3*Z)*Z^3) - (4*S^2*(S_v)^2)/(exp(2*Z)*Z^3) + \\
& (S^2*(S_v)^2)/(2*exp(Z)*Z^3) - (S^2*(S_v)^2)/(2*exp(3.*Y.*Z)*Z^3) ... \\
& - (S^2*(S_v)^2)/(2*exp(Y.*Z)*Z^3) - (3*exp(-2*Z - 3.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) + (2*exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_v)^2)/Z^3 - (3*exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) ...
\end{aligned}$$

$$\begin{aligned}
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) - (9*\exp(-4*Z \\
& - Y.*Z)*S^2*(S_v)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_v)^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_v)^2)/Z^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& - (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^3) + (4*S^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 ... \\
& - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 + (S^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (3*S^2*(S_v)^2)/(\exp(5*Z)*Z^2) + \\
& (19*S^2*(S_v)^2)/(\exp(4*Z)*Z^2) ... \\
& - (19*S^2*(S_v)^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_v)^2)/(\exp(Z)*Z^2) + (S^2*(S_v)^2)/(4*\exp(4.*Y.*Z)*Z^2) ... \\
& + (S^2*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S^2*(S_v)^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S^2*(S_v)^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^2 ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_v)^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_v)^2)/Z^2 + (5*\exp(-3*Z \\
& - Y.*Z)*S^2*(S_v)^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z^2 ... \\
& + (\exp(-Z - Y.*Z)*S^2*(S_v)^2)/(4*Z^2) - (S^2.*Y.*(S_v)^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^2) ... \\
& - (29*S^2.*Y.*(S_v)^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_v)^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/Z^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_v)^2)/(\exp(5*Z)*Z^2) ... \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_v)^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_v)^2)/(\exp(Z)*Z^2) ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z^2 - \\
& (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2*(S_v)^2)/(2*\exp(5*Z)*Z) - (S^2*(S_v)^2)/(\exp(4*Z)*Z) ... \\
& + (25*S^2*(S_v)^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_v)^2)/(\exp(2*Z)*Z) + (3*S^2*(S_v)^2)/(4*\exp(Z)*Z) \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z) ... \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_v)^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_v)^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z ... \\
& - (9*S^2.*Y.*(S_v)^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z) ... \\
& - (7*S^2.*Y.*(S_v)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_v)^2)/Z + (15*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)*Z) ... \\
& - (13*S^2.*Y.^2*(S_v)^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_v)^2)/(4*\exp(Z)*Z) ... \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z + \\
& (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z) ... \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z)*Z) ... \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z)*Z) - (3*S^2*Z*(S_v)^2)/(4*\exp(5*Z)) - \\
& (3*S^2*Z*(S_v)^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_v)^2)/\exp(3*Z) + (S^2.*Y.^2*Z*(S_v)^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^2*Z*(S_v)^2)/(2*\exp(3*Z)) - (S^2.*Y.^3*Z*(S_v)^2)/\exp(3*Z) + \\
& (3*S^2.*Y.^4*Z*(S_v)^2)/(4*\exp(5*Z)) - (S^2.*Y.^4*Z*(S_v)^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^4*Z*(S_v)^2)/(4*\exp(3*Z)) + (S^2*Z^2*(S_v)^2)/(4*\exp(4*Z)) - \\
& (S^2.*Y.^2*Z^2*(S_v)^2)/(2*\exp(4*Z)) + (S^2.*Y.^4*Z^2*(S_v)^2)/(4*\exp(4*Z));
\end{aligned}$$

Br1=0.2;

Nf1=Br1*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];

Ns1=Nf1+Nc+Ny;

Phi1=Nf1./[Nc+Ny];

Be1=1./[1+Phi1];

```

Gf1=Nf1./Ns1;
Gh1=[Nc+Ny]./Ns1;

Br2=0.4;
Nf2=Br2*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];
Ns2=Nf2+Nc+Ny;
Phi2=Nf2./[Nc+Ny];
Be2=1./[1+Phi2];
Gf2=Nf2./Ns2;
Gh2=[Nc+Ny]./Ns2;

Br3=0.6;
Nf3=Br3*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];
Ns3=Nf3+Nc+Ny;
Phi3=Nf3./[Nc+Ny];
Be3=1./[1+Phi3];
Gf3=Nf3./Ns3;
Gh3=[Nc+Ny]./Ns3;

Br4=0.8;
Nf4=Br4*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];
Ns4=Nf4+Nc+Ny;
Phi4=Nf4./[Nc+Ny];
Be4=1./[1+Phi4];
Gf4=Nf4./Ns4;
Gh4=[Nc+Ny]./Ns4;

Br5=1;
Nf5=Br5*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];
Ns5=Nf5+Nc+Ny;
Phi5=Nf5./[Nc+Ny];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gh5=[Nc+Ny]./Ns5;

Nh=Nc+Ny;

plot(Y,Ns1,'b',Y,Ns2,'g',Y,Ns3,'r',Y,Ns4,'k',Y,Ns5,'m')

% plot(Y,Be1,'b',Y,Be2,'g',Y,Be3,'r',Y,Be4,'k',Y,Be5,'m')

% plot(Y,Phi1,'b',Y,Phi2,'g',Y,Phi3,'r',Y,Phi4,'k',Y,Phi5,'m')

% plot(Y,Gf1,'b',Y,Gf2,'g',Y,Gf3,'r',Y,Gf4,'k',Y,Gf5,'m')

% plot(Y,Gh1,'b',Y,Gh2,'g',Y,Gh3,'r',Y,Gh4,'k',Y,Gh5,'m')

% plot(Y,Nf1,'b',Y,Nf2,'g',Y,Nf3,'r',Y,Nf4,'k',Y,Nf5,'m')

% plot(Y,Nh)

% plot(Nh,Nf1,'b',Nh,Nf2,'g',Nh,Nf3,'r',Nh,Nf4,'k',Nh,Nf5,'m')

```

PLOTTOOLS ON

1.2. Distribution of $N_S, Be, \Phi, G_F, G_H, N_F$ and N_H versus Y for a range of

Z and set of S, S_v, Br & Pe

```
S=1; S_v=1; Br=1; Pe=10;
% S=5; S_v=0.75; Br=0.5; Pe=2;
% % % % S=2; S_v=1; Br=0.8; Pe=0.5;
% % % % S=7.5; S_v=15; Br=0.6; Pe=2.5;
% % % % S=10; S_v=5; Br=0.9; Pe=5;
% % % % S=20; S_v=5; Br=0.2; Pe=0.5;
```

```
q=1.86;
s=1;
Dh=250*10^-6;
Y=0:0.005:1;
```

```
Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
```

```
Z1=6.5;
Nf1=Br*[(Z1^2)*exp(-2.*Y.*Z1)+(Z1^2)*exp(-2*Z1)-2*Z1^2.*exp(-Z1-Y.*Z1)];
Ny1=1 - exp(-2*Z1) + exp(-Z1 - Y.*Z1) - (2*S)/exp(2*Z1) + 2*exp(-Z1 - Y.*Z1)*S - S^2/exp(2*Z1) +
exp(-Z1 - Y.*Z1)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z1) - exp(-Z1 - Y.*Z1).*Y.^2 ...
+ (2*S.*Y.^2)/exp(2*Z1) - 2*exp(-Z1 - Y.*Z1)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z1) - exp(-Z1 -
Y.*Z1)*S^2.*Y.^2 + 1/(exp(2*Z1)*Z1^2) + 1./(exp(2.*Y.*Z1)*Z1^2) ...
- (2*exp(-Z1 - Y.*Z1))/Z1^2 + (2*S)/(exp(2*Z1)*Z1^2) + (2*S)/(exp(2.*Y.*Z1)*Z1^2) - (4*exp(-Z1 -
Y.*Z1)*S)/Z1^2 + S^2/(exp(2*Z1)*Z1^2) + S^2./(exp(2.*Y.*Z1)*Z1^2) ...
- (2*exp(-Z1 - Y.*Z1)*S^2)/Z1^2 + 2/(exp(Z1)*Z1) - 2./(exp(Y.*Z1)*Z1) + (2*S)/(exp(Z1)*Z1) -
(2*S)/(exp(Y.*Z1)*Z1) - (2.*Y)/(exp(Z1)*Z1) + (2.*Y)/(exp(Y.*Z1)*Z1) ...
- (2*S.*Y)/(exp(Z1)*Z1) + (2*S.*Y)/(exp(Y.*Z1)*Z1) - Z1/exp(Z1) - (S*Z1)/exp(Z1) +
(Y.*Z1)/exp(Z1) + (S.*Y.*Z1)/exp(Z1) + (Y.^2*Z1)/exp(Z1) + (S.*Y.^2*Z1)/exp(Z1) - (Y.^3*Z1)/exp(Z1)
...
- (S.*Y.^3*Z1)/exp(Z1) + Z1^2/(4*exp(2*Z1)) + (S*Z1^2)/(2*exp(2*Z1)) + (S^2*Z1^2)/(4*exp(2*Z1))
- (Y.^2*Z1^2)/(2*exp(2*Z1)) - (S.*Y.^2*Z1^2)/exp(2*Z1) ...
- (S^2.*Y.^2*Z1^2)/(2*exp(2*Z1)) + (Y.^4*Z1^2)/(4*exp(2*Z1)) + (S.*Y.^4*Z1^2)/(2*exp(2*Z1)) +
(S^2.*Y.^4*Z1^2)/(4*exp(2*Z1)) - (7*S*(S_v))/(2*exp(3*Z1)) ...
+ (2*S*(S_v))/exp(2*Z1) + (S*(S_v))/exp(Z1) - (exp(-Z1 - 2.*Y.*Z1)*S*(S_v))/2 -
(5*S^2*(S_v))/exp(3*Z1) + (2*S^2*(S_v))/exp(2*Z1) - (S^2*(S_v))/(2*exp(Z1)) ...
- (exp(-Z1 - 2.*Y.*Z1)*S^2*(S_v))/2 - (2*S.*Y.*(S_v))/exp(2*Z1) - (3*S.*Y.*(S_v))/exp(Z1) +
(3*S^2.*Y.*(S_v))/(2*exp(3*Z1)) - (2*S^2.*Y.*(S_v))/exp(2*Z1) ...
+ (S^2.*Y.*(S_v))/(2*exp(Z1)) + (13*S.*Y.^2*(S_v))/(2*exp(3*Z1)) - (4*S.*Y.^2*(S_v))/exp(2*Z1) +
(3*S.*Y.^2*(S_v))/exp(Z1) + (exp(-Z1 - 2.*Y.*Z1)*S.*Y.^2*(S_v))/2 ...
+ (5*S^2.*Y.^2*(S_v))/exp(3*Z1) - (2*S^2.*Y.^2*(S_v))/exp(2*Z1) + (S^2.*Y.^2*(S_v))/(2*exp(Z1))
+ (exp(-Z1 - 2.*Y.*Z1)*S^2.*Y.^2*(S_v))/2 - (3*S.*Y.^3*(S_v))/exp(3*Z1) ...
+ (4*S.*Y.^3*(S_v))/exp(2*Z1) - (S.*Y.^3*(S_v))/exp(Z1) - (3*S^2.*Y.^3*(S_v))/(2*exp(3*Z1)) +
(2*S^2.*Y.^3*(S_v))/exp(2*Z1) - (S^2.*Y.^3*(S_v))/(2*exp(Z1)) ...
+ (3*S*(S_v))/(exp(4*Z1)*Z1^3) - (4*S*(S_v))/(exp(3*Z1)*Z1^3) + (S*(S_v))/(exp(2*Z1)*Z1^3) +
(S*(S_v))/(exp(2.*Y.*Z1)*Z1^3) + (3*exp(-2*Z1 - 2.*Y.*Z1)*S*(S_v))/Z1^3 ...
- (4*exp(-Z1 - 2.*Y.*Z1)*S*(S_v))/Z1^3 - (6*exp(-3*Z1 - Y.*Z1)*S*(S_v))/Z1^3 + (8*exp(-2*Z1 -
Y.*Z1)*S*(S_v))/Z1^3 - (2*exp(-Z1 - Y.*Z1)*S*(S_v))/Z1^3 ...
```

$$\begin{aligned}
& + \frac{(3*S^2*(S_v))}{(\exp(4*Z1)*Z1^3)} - \frac{(4*S^2*(S_v))}{(\exp(3*Z1)*Z1^3)} + \frac{(S^2*(S_v))}{(\exp(2*Z1)*Z1^3)} + \frac{(S^2*(S_v))}{(\exp(2.*Y.*Z1)*Z1^3)} + (3*\exp(-2*Z1 - 2.*Y.*Z1)*S^2*(S_v))/Z1^3 \dots \\
& - (4*\exp(-Z1 - 2.*Y.*Z1)*S^2*(S_v))/Z1^3 - (6*\exp(-3*Z1 - Y.*Z1)*S^2*(S_v))/Z1^3 + (8*\exp(-2*Z1 - Y.*Z1)*S^2*(S_v))/Z1^3 - (2*\exp(-Z1 - Y.*Z1)*S^2*(S_v))/Z1^3 \dots \\
& + (11*S*(S_v))/(\exp(3*Z1)*Z1^2) - (8*S*(S_v))/(\exp(2*Z1)*Z1^2) + (2*S*(S_v))/(\exp(Z1)*Z1^2) - (S*(S_v))/(\exp(3.*Y.*Z1)*Z1^2) - (2*S*(S_v))/(\exp(Y.*Z1)*Z1^2) \dots \\
& - (\exp(-Z1 - 2.*Y.*Z1)*S*(S_v))/Z1^2 - (9*\exp(-2*Z1 - Y.*Z1)*S*(S_v))/Z1^2 + (8*\exp(-Z1 - Y.*Z1)*S*(S_v))/Z1^2 + (8*S^2*(S_v))/(\exp(3*Z1)*Z1^2); \dots \\
& - \frac{(4*S^2*(S_v))}{(\exp(2*Z1)*Z1^2)} + \frac{(S^2*(S_v))}{(\exp(Z1)*Z1^2)} - \frac{(S^2*(S_v))}{(\exp(3.*Y.*Z1)*Z1^2)} - \frac{(S^2*(S_v))}{(\exp(Y.*Z1)*Z1^2)} - (\exp(-Z1 - 2.*Y.*Z1)*S^2*(S_v))/Z1^2 \dots \\
& - (6*\exp(-2*Z1 - Y.*Z1)*S^2*(S_v))/Z1^2 + (4*\exp(-Z1 - Y.*Z1)*S^2*(S_v))/Z1^2 - (6*S.*Y.*(S_v))/(\exp(3*Z1)*Z1^2) + (8*S.*Y.*(S_v))/(\exp(2*Z1)*Z1^2) \dots \\
& - (2*S.*Y.*(S_v))/(\exp(Z1)*Z1^2) + (2*S.*Y.*(S_v))/(\exp(Y.*Z1)*Z1^2) + (6*\exp(-2*Z1 - Y.*Z1)*S.*Y.*(S_v))/Z1^2 - (8*\exp(-Z1 - Y.*Z1)*S.*Y.*(S_v))/Z1^2 \dots \\
& - \frac{(3*S^2.*Y.*(S_v))}{(\exp(3*Z1)*Z1^2)} + \frac{(4*S^2.*Y.*(S_v))}{(\exp(2*Z1)*Z1^2)} - \frac{(S^2.*Y.*(S_v))}{(\exp(Z1)*Z1^2)} + \frac{(S^2.*Y.*(S_v))}{(\exp(Y.*Z1)*Z1^2)} \dots \\
& + (3*\exp(-2*Z1 - Y.*Z1)*S^2.*Y.*(S_v))/Z1^2 - (4*\exp(-Z1 - Y.*Z1)*S^2.*Y.*(S_v))/Z1^2 + (S*(S_v))/Z1 + (2*S*(S_v))/(\exp(3*Z1)*Z1) + (9*S*(S_v))/(\exp(2*Z1)*Z1) \dots \\
& - (4*S*(S_v))/(\exp(Z1)*Z1) + (S*(S_v))/(\exp(2.*Y.*Z1)*Z1) - (2*\exp(-2*Z1 - Y.*Z1)*S*(S_v))/Z1 + (\exp(-Z1 - Y.*Z1)*S*(S_v))/Z1 + (2*S^2*(S_v))/(\exp(3*Z1)*Z1) \dots \\
& + \frac{(S^2*(S_v))}{(\exp(2*Z1)*Z1)} - \frac{(2*\exp(-2*Z1 - Y.*Z1)*S^2*(S_v))/Z1}{(\exp(3*Z1)*Z1)} - (\exp(-Z1 - Y.*Z1)*S^2*(S_v))/Z1 - (2*S.*Y.*(S_v))/Z1 - (13*S.*Y.*(S_v))/(\exp(2*Z1)*Z1) \dots \\
& + \frac{(8*S.*Y.*(S_v))}{(\exp(Z1)*Z1)} - \frac{(S.*Y.*(S_v))}{(\exp(2.*Y.*Z1)*Z1)} - \frac{(2*S^2.*Y.*(S_v))}{(\exp(2*Z1)*Z1)} + \frac{(2*\exp(-Z1 - Y.*Z1)*S^2.*Y.*(S_v))/Z1}{(\exp(3*Z1)*Z1)} + \frac{(S.*Y.^2*(S_v))/Z1}{(\exp(2*Z1)*Z1)} \dots \\
& + \frac{(3*S.*Y.^2*(S_v))}{(\exp(4*Z1)*Z1)} - \frac{(4*S.*Y.^2*(S_v))}{(\exp(3*Z1)*Z1)} + \frac{(4*S.*Y.^2*(S_v))}{(\exp(2*Z1)*Z1)} - \frac{(4*S.*Y.^2*(S_v))}{(\exp(Z1)*Z1)} \dots \\
& - (3*\exp(-3*Z1 - Y.*Z1)*S.*Y.^2*(S_v))/Z1 + (4*\exp(-2*Z1 - Y.*Z1)*S.*Y.^2*(S_v))/Z1 - (\exp(-Z1 - Y.*Z1)*S.*Y.^2*(S_v))/Z1 + (3*S^2.*Y.^2*(S_v))/(\exp(4*Z1)*Z1) \dots \\
& - \frac{(4*S^2.*Y.^2*(S_v))}{(\exp(3*Z1)*Z1)} + \frac{(S^2.*Y.^2*(S_v))}{(\exp(2*Z1)*Z1)} - (3*\exp(-3*Z1 - Y.*Z1)*S^2.*Y.^2*(S_v))/Z1 + (4*\exp(-2*Z1 - Y.*Z1)*S^2.*Y.^2*(S_v))/Z1 \dots \\
& - (\exp(-Z1 - Y.*Z1)*S^2.*Y.^2*(S_v))/Z1 - \frac{(3*S^2*Z1*(S_v))/(4*\exp(4*Z1))}{(4*\exp(2*Z1))} - \frac{(3*S^2*Z1*(S_v))/(4*\exp(4*Z1))}{(4*\exp(2*Z1))} \dots \\
& + \frac{(2*S.*Y.*Z1*(S_v))/\exp(2*Z1)}{(4*\exp(2*Z1))} + \frac{(S^2.*Y.*Z1*(S_v))/\exp(2*Z1)}{(4*\exp(2*Z1))} + \frac{(S.*Y.^2*Z1*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} + \frac{(3*S.*Y.^2*Z1*(S_v))/\exp(2*Z1)}{(4*\exp(2*Z1))} + \frac{(S^2.*Y.^2*Z1*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} \dots \\
& + \frac{(S^2.*Y.^2*Z1*(S_v))/(2*\exp(2*Z1))}{(4*\exp(2*Z1))} - \frac{(2*S.*Y.^3*Z1*(S_v))/\exp(2*Z1)}{(4*\exp(2*Z1))} - \frac{(S^2.*Y.^3*Z1*(S_v))/\exp(2*Z1)}{(4*\exp(2*Z1))} + \frac{(3*S.*Y.^4*Z1*(S_v))/(4*\exp(4*Z1))}{(4*\exp(2*Z1))} \dots \\
& + \frac{(S.*Y.^4*Z1*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} + \frac{(3*S^2.*Y.^4*Z1*(S_v))/(4*\exp(4*Z1))}{(4*\exp(2*Z1))} + \frac{(S^2.*Y.^4*Z1*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} + \frac{(S^2.*Y.^4*Z1*(S_v))/(4*\exp(2*Z1))}{(4*\exp(2*Z1))} \dots \\
& + \frac{(S^2*Z1^2*(S_v))/(2*\exp(3*Z1))}{(4*\exp(2*Z1))} - \frac{(S.*Y.^2*Z1^2*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} - \frac{(S^2.*Y.^2*Z1^2*(S_v))/\exp(3*Z1)}{(4*\exp(2*Z1))} + \frac{(S.*Y.^4*Z1^2*(S_v))/(2*\exp(3*Z1))}{(4*\exp(2*Z1))} \dots \\
& + \frac{(S^2.*Y.^4*Z1^2*(S_v))/(2*\exp(3*Z1))}{(4*\exp(2*Z1))} + \frac{(9*S^2*(S_v)^2)/(16*\exp(6*Z1))}{(4*\exp(2*Z1))} - \frac{(23*S^2*(S_v)^2)/(8*\exp(4*Z1))}{(4*\exp(2*Z1))} + \frac{(2*S^2*(S_v)^2)/\exp(3*Z1)}{(4*\exp(2*Z1))} + \frac{(S^2*(S_v)^2)/(16*\exp(2*Z1))}{(4*\exp(2*Z1))} \dots \\
& - (\exp(-2*Z1 - 2.*Y.*Z1)*S^2*(S_v)^2)/2 - \exp(-3*Z1 - Y.*Z1)*S^2*(S_v)^2 - (2*S^2.*Y.*(S_v)^2)/\exp(3*Z1) - (S^2.*Y.*(S_v)^2)/\exp(2*Z1) + (9*S^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z1)) \dots \\
& \dots \\
& - \frac{(3*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z1))}{(4*\exp(2*Z1))} + \frac{(11*S^2.*Y.^2*(S_v)^2)/(2*\exp(4*Z1))}{(4*\exp(2*Z1))} - \frac{(7*S^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z1))}{(4*\exp(2*Z1))} + \frac{(15*S^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z1))}{(4*\exp(2*Z1))} \dots \\
& + (\exp(-2*Z1 - 2.*Y.*Z1)*S^2.*Y.^2*(S_v)^2)/2 + \exp(-3*Z1 - Y.*Z1)*S^2.*Y.^2*(S_v)^2 - (3*S^2.*Y.^3*(S_v)^2)/\exp(4*Z1) + (4*S^2.*Y.^3*(S_v)^2)/\exp(3*Z1) \dots \\
& - \frac{(S^2.*Y.^3*(S_v)^2)/\exp(2*Z1)}{(4*\exp(2*Z1))} + \frac{(9*S^2.*Y.^4*(S_v)^2)/(16*\exp(6*Z1))}{(4*\exp(2*Z1))} - \frac{(3*S^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z1))}{(4*\exp(2*Z1))} + \frac{(11*S^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z1))}{(4*\exp(2*Z1))} \dots
\end{aligned}$$

$$\begin{aligned}
& - \frac{(S^2 \cdot Y \cdot ^4(S_v)^2)/(2 \cdot \exp(3 \cdot Z1))}{(9 \cdot S^2 \cdot (S_v)^2)/(4 \cdot \exp(6 \cdot Z1) \cdot Z1^4) - (6 \cdot S^2 \cdot (S_v)^2)/(\exp(5 \cdot Z1) \cdot Z1^4) \dots} + \frac{(S^2 \cdot Y \cdot ^4(S_v)^2)/(16 \cdot \exp(2 \cdot Z1))}{(11 \cdot S^2 \cdot (S_v)^2)/(2 \cdot \exp(4 \cdot Z1) \cdot Z1^4) - (2 \cdot S^2 \cdot (S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1^4) +} \\
& \frac{(S^2 \cdot (S_v)^2)/(4 \cdot \exp(2 \cdot Z1) \cdot Z1^4) + (S^2 \cdot (S_v)^2)/(4 \cdot \exp(2 \cdot Y \cdot Z1) \cdot Z1^4) \dots}{(9 \cdot \exp(-4 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(4 \cdot Z1^4) - (6 \cdot \exp(-3 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^4 +} \\
& \frac{(11 \cdot \exp(-2 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^4) \dots}{(2 \cdot \exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^4 - (9 \cdot \exp(-5 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^4) +} \\
& \frac{(12 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^4 - (11 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^4 \dots}{(4 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^4 - (\exp(-Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^4) +} \\
& \frac{(12 \cdot S^2 \cdot (S_v)^2)/(\exp(5 \cdot Z1) \cdot Z1^3) - (22 \cdot S^2 \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1^3) \dots}{(27 \cdot S^2 \cdot (S_v)^2)/(2 \cdot \exp(3 \cdot Z1) \cdot Z1^3) - (4 \cdot S^2 \cdot (S_v)^2)/(\exp(2 \cdot Z1) \cdot Z1^3) +} \\
& \frac{(S^2 \cdot (S_v)^2)/(2 \cdot \exp(Z1) \cdot Z1^3) - (S^2 \cdot (S_v)^2)/(2 \cdot \exp(3 \cdot Y \cdot Z1) \cdot Z1^3) \dots}{(S^2 \cdot (S_v)^2)/(2 \cdot \exp(Y \cdot Z1) \cdot Z1^3) - (3 \cdot \exp(-2 \cdot Z1 - 3 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^3) +} \\
& \frac{(2 \cdot \exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^3) + (2 \cdot \exp(-Z1 - 3 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^3 - (3 \cdot \exp(-3 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^3) \dots}{(2 \cdot \exp(-2 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^3 - (\exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^3) -} \\
& \frac{(9 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^3 + (18 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^3 \dots}{(25 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(2 \cdot Z1^3) + (4 \cdot \exp(-Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^3 -} \\
& \frac{(9 \cdot S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot \exp(5 \cdot Z1) \cdot Z1^3) + (12 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1^3) \dots}{(11 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1^3) + (4 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(2 \cdot Z1) \cdot Z1^3) -} \\
& \frac{(S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot \exp(Z1) \cdot Z1^3) + (S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot \exp(Y \cdot Z1) \cdot Z1^3) \dots}{(9 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot Z1^3) - (12 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1^3 +} \\
& \frac{(11 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1^3 \dots}{(4 \cdot \exp(-Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1^3 + (S^2 \cdot (S_v)^2)/(4 \cdot Z1^2) +} \\
& \frac{(9 \cdot S^2 \cdot (S_v)^2)/(4 \cdot \exp(6 \cdot Z1) \cdot Z1^2) - (3 \cdot S^2 \cdot (S_v)^2)/(\exp(5 \cdot Z1) \cdot Z1^2) +}{(19 \cdot S^2 \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1^2) \dots} \\
& \frac{(19 \cdot S^2 \cdot (S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1^2) + (35 \cdot S^2 \cdot (S_v)^2)/(4 \cdot \exp(2 \cdot Z1) \cdot Z1^2) -}{(2 \cdot S^2 \cdot (S_v)^2)/(\exp(Z1) \cdot Z1^2) + (S^2 \cdot (S_v)^2)/(4 \cdot \exp(4 \cdot Y \cdot Z1) \cdot Z1^2) \dots} \\
& \frac{(S^2 \cdot (S_v)^2)/(2 \cdot \exp(2 \cdot Y \cdot Z1) \cdot Z1^2) + (\exp(-Z1 - 3 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 + (5 \cdot \exp(-2 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 - (2 \cdot \exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 \dots}{(9 \cdot \exp(-5 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(4 \cdot Z1^2) + (3 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 +} \\
& \frac{(5 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 - (\exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1^2 \dots}{(exp(-Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(4 \cdot Z1^2) - (S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot Z1^2) -} \\
& \frac{(15 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1^2) + (26 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1^2) \dots}{(29 \cdot S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot \exp(2 \cdot Z1) \cdot Z1^2) + (4 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(Z1) \cdot Z1^2) -} \\
& \frac{(S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot \exp(2 \cdot Y \cdot Z1) \cdot Z1^2) - (3 \cdot \exp(-2 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/(2 \cdot Z1^2) \dots}{(2 \cdot \exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1^2 + (S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot Z1^2) +} \\
& \frac{(9 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot \exp(6 \cdot Z1) \cdot Z1^2) - (6 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(\exp(5 \cdot Z1) \cdot Z1^2) \dots}{(31 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot \exp(4 \cdot Z1) \cdot Z1^2) - (8 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1^2) +} \\
& \frac{(23 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot \exp(2 \cdot Z1) \cdot Z1^2) - (2 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(\exp(Z1) \cdot Z1^2) \dots}{(9 \cdot \exp(-5 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot Z1^2) + (6 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/Z1^2 -} \\
& \frac{(11 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(2 \cdot Z1^2) \dots}{(2 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/Z1^2 - (\exp(-Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot Z1^2) +} \\
& \frac{(9 \cdot S^2 \cdot (S_v)^2)/(2 \cdot \exp(5 \cdot Z1) \cdot Z1) - (S^2 \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1) \dots}{(25 \cdot S^2 \cdot (S_v)^2)/(4 \cdot \exp(3 \cdot Z1) \cdot Z1) - (3 \cdot S^2 \cdot (S_v)^2)/(\exp(2 \cdot Z1) \cdot Z1) +} \\
& \frac{(3 \cdot S^2 \cdot (S_v)^2)/(4 \cdot \exp(Z1) \cdot Z1) + (3 \cdot \exp(-3 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(4 \cdot Z1) \dots}{(3 \cdot \exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/(4 \cdot Z1) + (3 \cdot \exp(-4 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1 -} \\
& \frac{(2 \cdot \exp(-3 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1 + (2 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot (S_v)^2)/Z1 \dots}{(9 \cdot S^2 \cdot Y \cdot (S_v)^2)/(4 \cdot \exp(5 \cdot Z1) \cdot Z1) + (3 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1) -} \\
& \frac{(11 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(3 \cdot Z1) \cdot Z1) + (7 \cdot S^2 \cdot Y \cdot (S_v)^2)/(\exp(2 \cdot Z1) \cdot Z1) \dots}{(7 \cdot S^2 \cdot Y \cdot (S_v)^2)/(4 \cdot \exp(Z1) \cdot Z1) - (\exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1 -} \\
& \frac{(2 \cdot \exp(-2 \cdot Z1 - Y \cdot Z1) \cdot S^2 \cdot Y \cdot (S_v)^2)/Z1 + (15 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(2 \cdot \exp(5 \cdot Z1) \cdot Z1) \dots}{(13 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(\exp(4 \cdot Z1) \cdot Z1) + (41 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot \exp(3 \cdot Z1) \cdot Z1) -} \\
& \frac{(6 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(\exp(2 \cdot Z1) \cdot Z1) + (5 \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot \exp(Z1) \cdot Z1) \dots}{(3 \cdot \exp(-3 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot Z1) - (\exp(-2 \cdot Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/Z1 +} \\
& \frac{(\exp(-Z1 - 2 \cdot Y \cdot Z1) \cdot S^2 \cdot Y \cdot ^2(S_v)^2)/(4 \cdot Z1) \dots}{}
\end{aligned}$$

$$\begin{aligned}
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z1)*Z1) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z1)*Z1) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z1)*Z1) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z1)*Z1) \dots \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z1)*Z1) - (3*S^2*Z1*(S_v)^2)/(4*\exp(5*Z1)) - \\
& (3*S^2*Z1*(S_v)^2)/(4*\exp(3*Z1)) + (S^2.*Y.*Z1*(S_v)^2)/\exp(3*Z1) + \\
& (S^2.*Y.^2*Z1*(S_v)^2)/\exp(4*Z1) \dots \\
& + (S^2.*Y.^2*Z1*(S_v)^2)/(2*\exp(3*Z1)) - (S^2.*Y.^3*Z1*(S_v)^2)/\exp(3*Z1) + \\
& (3*S^2.*Y.^4*Z1*(S_v)^2)/(4*\exp(5*Z1)) - (S^2.*Y.^4*Z1*(S_v)^2)/\exp(4*Z1) \dots \\
& + (S^2.*Y.^4*Z1*(S_v)^2)/(4*\exp(3*Z1)) + (S^2*Z1^2*(S_v)^2)/(4*\exp(4*Z1)) - \\
& (S^2.*Y.^2*Z1^2*(S_v)^2)/(2*\exp(4*Z1)) + (S^2.*Y.^4*Z1^2*(S_v)^2)/(4*\exp(4*Z1));
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf1 + Nc + Ny1; \\
Phi1 &= Nf1 / [Nc + Ny1]; \\
Be1 &= 1 / [1 + Phi1]; \\
Gf1 &= Nf1 / Ns1; \\
Gh1 &= [Nc + Ny1] / Ns1; \\
Nh1 &= Nc + Ny1;
\end{aligned}$$

$$\begin{aligned}
Z2 &= 7.5; \\
Nf2 &= Br * [(Z2^2) * \exp(-2.*Y.*Z2) + (Z2^2) * \exp(-2*Z2) - 2*Z2^2 * \exp(-Z2 - Y.*Z2)]; \\
Ny2 &= 1 - \exp(-2*Z2) + \exp(-Z2 - Y.*Z2) - (2*S)/\exp(2*Z2) + 2*\exp(-Z2 - Y.*Z2)*S - S^2/\exp(2*Z2) + \\
& \exp(-Z2 - Y.*Z2)*S^2 - 2.*Y + Y.^2 + Y.^2/\exp(2*Z2) - \exp(-Z2 - Y.*Z2).*Y.^2 \dots \\
& + (2*S.*Y.^2)/\exp(2*Z2) - 2*\exp(-Z2 - Y.*Z2)*S.*Y.^2 + (S^2.*Y.^2)/\exp(2*Z2) - \exp(-Z2 - \\
& Y.*Z2)*S^2.*Y.^2 + 1/(\exp(2*Z2)*Z2^2) + 1./(\exp(2.*Y.*Z2)*Z2^2) \dots \\
& - (2*\exp(-Z2 - Y.*Z2))/Z2^2 + (2*S)/(\exp(2*Z2)*Z2^2) + (2*S)/(\exp(2.*Y.*Z2)*Z2^2) - (4*\exp(-Z2 - \\
& Y.*Z2)*S)/Z2^2 + S^2/(\exp(2*Z2)*Z2^2) + S^2./(\exp(2.*Y.*Z2)*Z2^2) \dots \\
& - (2*\exp(-Z2 - Y.*Z2)*S^2)/Z2^2 + 2/(\exp(Z2)*Z2) - 2./(\exp(Y.*Z2)*Z2) + (2*S)/(\exp(Z2)*Z2) - \\
& (2*S)/(\exp(Y.*Z2)*Z2) - (2.*Y)/(\exp(Z2)*Z2) + (2.*Y)/(\exp(Y.*Z2)*Z2) \dots \\
& - (2*S.*Y)/(\exp(Z2)*Z2) + (2*S.*Y)/(\exp(Y.*Z2)*Z2) - Z2/\exp(Z2) - (S*Z2)/\exp(Z2) + \\
& (Y.*Z2)/\exp(Z2) + (S.*Y.*Z2)/\exp(Z2) + (Y.^2*Z2)/\exp(Z2) + (S.*Y.^2*Z2)/\exp(Z2) - (Y.^3*Z2)/\exp(Z2) \\
& \dots \\
& - (S.*Y.^3*Z2)/\exp(Z2) + Z2^2/(4*\exp(2*Z2)) + (S*Z2^2)/(2*\exp(2*Z2)) + (S^2*Z2^2)/(4*\exp(2*Z2)) \\
& - (Y.^2*Z2^2)/(2*\exp(2*Z2)) - (S.*Y.^2*Z2^2)/\exp(2*Z2) \dots \\
& - (S^2.*Y.^2*Z2^2)/(2*\exp(2*Z2)) + (Y.^4*Z2^2)/(4*\exp(2*Z2)) + (S.*Y.^4*Z2^2)/(2*\exp(2*Z2)) + \\
& (S^2.*Y.^4*Z2^2)/(4*\exp(2*Z2)) - (7*S*(S_v))/(2*\exp(3*Z2)) \dots \\
& + (2*S*(S_v))/\exp(2*Z2) + (S*(S_v))/\exp(Z2) - (\exp(-Z2 - 2.*Y.*Z2)*S*(S_v))/2 - \\
& (5*S^2*(S_v))/\exp(3*Z2) + (2*S^2*(S_v))/\exp(2*Z2) - (S^2*(S_v))/(2*\exp(Z2)) \dots \\
& - (\exp(-Z2 - 2.*Y.*Z2)*S^2*(S_v))/2 - (2*S.*Y.*(S_v))/\exp(2*Z2) - (3*S.*Y.*(S_v))/\exp(Z2) + \\
& (3*S^2.*Y.*(S_v))/(2*\exp(3*Z2)) - (2*S^2.*Y.*(S_v))/\exp(2*Z2) \dots \\
& + (S^2.*Y.*(S_v))/(2*\exp(Z2)) + (13*S.*Y.^2*(S_v))/(2*\exp(3*Z2)) - (4*S.*Y.^2*(S_v))/\exp(2*Z2) + \\
& (3*S.*Y.^2*(S_v))/\exp(Z2) + (\exp(-Z2 - 2.*Y.*Z2)*S.*Y.^2*(S_v))/2 \dots \\
& + (5*S^2.*Y.^2*(S_v))/\exp(3*Z2) - (2*S^2.*Y.^2*(S_v))/\exp(2*Z2) + (S^2.*Y.^2*(S_v))/(2*\exp(Z2)) \\
& + (\exp(-Z2 - 2.*Y.*Z2)*S^2.*Y.^2*(S_v))/2 - (3*S.*Y.^3*(S_v))/\exp(3*Z2) \dots \\
& + (4*S.*Y.^3*(S_v))/\exp(2*Z2) - (S.*Y.^3*(S_v))/\exp(Z2) - (3*S^2.*Y.^3*(S_v))/(2*\exp(3*Z2)) + \\
& (2*S^2.*Y.^3*(S_v))/\exp(2*Z2) - (S^2.*Y.^3*(S_v))/(2*\exp(Z2)) \dots \\
& + (3*S*(S_v))/(\exp(4*Z2)*Z2^3) - (4*S*(S_v))/(\exp(3*Z2)*Z2^3) + (S*(S_v))/(\exp(2*Z2)*Z2^3) + \\
& (S*(S_v))/(\exp(2.*Y.*Z2)*Z2^3) + (3*\exp(-2*Z2 - 2.*Y.*Z2)*S*(S_v))/Z2^3 \dots \\
& - (4*\exp(-Z2 - 2.*Y.*Z2)*S*(S_v))/Z2^3 - (6*\exp(-3*Z2 - Y.*Z2)*S*(S_v))/Z2^3 + (8*\exp(-2*Z2 - \\
& Y.*Z2)*S*(S_v))/Z2^3 - (2*\exp(-Z2 - Y.*Z2)*S*(S_v))/Z2^3 \dots \\
& + (3*S^2*(S_v))/(\exp(4*Z2)*Z2^3) - (4*S^2*(S_v))/(\exp(3*Z2)*Z2^3) + \\
& (S^2*(S_v))/(\exp(2*Z2)*Z2^3) + (S^2*(S_v))/(\exp(2.*Y.*Z2)*Z2^3) + (3*\exp(-2*Z2 - \\
& 2.*Y.*Z2)*S^2*(S_v))/Z2^3 \dots \\
& - (4*\exp(-Z2 - 2.*Y.*Z2)*S^2*(S_v))/Z2^3 - (6*\exp(-3*Z2 - Y.*Z2)*S^2*(S_v))/Z2^3 + (8*\exp(-2*Z2 - \\
& Y.*Z2)*S^2*(S_v))/Z2^3 - (2*\exp(-Z2 - Y.*Z2)*S^2*(S_v))/Z2^3 \dots \\
& + (11*S*(S_v))/(\exp(3*Z2)*Z2^2) - (8*S*(S_v))/(\exp(2*Z2)*Z2^2) + (2*S*(S_v))/(\exp(Z2)*Z2^2) - \\
& (S*(S_v))/(\exp(3.*Y.*Z2)*Z2^2) - (2*S*(S_v))/(\exp(Y.*Z2)*Z2^2) \dots
\end{aligned}$$

$$\begin{aligned}
& - (\exp(-Z^2 - 2*Y.*Z^2)*S*(S_v))/Z^2 - (9*\exp(-2*Z^2 - Y.*Z^2)*S*(S_v))/Z^2 + (8*\exp(-Z^2 - Y.*Z^2)*S*(S_v))/Z^2 + (8*S^2*(S_v))/(exp(3*Z^2)*Z^2); \dots \\
& - (4*S^2*(S_v))/(exp(2*Z^2)*Z^2) + (S^2*(S_v))/(exp(Z^2)*Z^2) - (S^2*(S_v))/(exp(3*Y.*Z^2)*Z^2) - (S^2*(S_v))/(exp(Y.*Z^2)*Z^2) - (exp(-Z^2 - 2*Y.*Z^2)*S^2*(S_v))/Z^2 \dots \\
& - (6*\exp(-2*Z^2 - Y.*Z^2)*S^2*(S_v))/Z^2 + (4*\exp(-Z^2 - Y.*Z^2)*S^2*(S_v))/Z^2 - (6*S.*Y*(S_v))/(exp(3*Z^2)*Z^2) + (8*S.*Y*(S_v))/(exp(2*Z^2)*Z^2) \dots \\
& - (2*S.*Y*(S_v))/(exp(Z^2)*Z^2) + (2*S.*Y*(S_v))/(exp(Y.*Z^2)*Z^2) + (6*\exp(-2*Z^2 - Y.*Z^2)*S.*Y*(S_v))/Z^2 - (8*\exp(-Z^2 - Y.*Z^2)*S.*Y*(S_v))/Z^2 \dots \\
& - (3*S^2.*Y*(S_v))/(exp(3*Z^2)*Z^2) + (4*S^2.*Y*(S_v))/(exp(2*Z^2)*Z^2) - (S^2.*Y*(S_v))/(exp(Z^2)*Z^2) + (S^2.*Y*(S_v))/(exp(Y.*Z^2)*Z^2) \dots \\
& + (3*\exp(-2*Z^2 - Y.*Z^2)*S^2.*Y*(S_v))/Z^2 - (4*\exp(-Z^2 - Y.*Z^2)*S^2.*Y*(S_v))/Z^2 + (S*(S_v))/Z^2 + (2*S*(S_v))/(exp(3*Z^2)*Z^2) + (9*S*(S_v))/(exp(2*Z^2)*Z^2) \dots \\
& - (4*S*(S_v))/(exp(Z^2)*Z^2) + (S*(S_v))/(exp(2*Y.*Z^2)*Z^2) - (2*\exp(-2*Z^2 - Y.*Z^2)*S*(S_v))/Z^2 + (exp(-Z^2 - Y.*Z^2)*S*(S_v))/Z^2 + (2*S^2*(S_v))/(exp(3*Z^2)*Z^2) \dots \\
& + (S^2*(S_v))/Z^2 - (2*S.*Y*(S_v))/Z^2 - (13*S.*Y*(S_v))/(exp(2*Z^2)*Z^2) - (exp(-Z^2 - Y.*Z^2)*S^2*(S_v))/Z^2 - (2*S.*Y*(S_v))/Z^2 - (13*S.*Y*(S_v))/(exp(2*Z^2)*Z^2) \dots \\
& + (8*S.*Y*(S_v))/(exp(Z^2)*Z^2) - (S.*Y*(S_v))/(exp(2*Y.*Z^2)*Z^2) - (2*S^2.*Y*(S_v))/(exp(2*Z^2)*Z^2) + (2*\exp(-Z^2 - Y.*Z^2)*S^2.*Y*(S_v))/Z^2 + (S.*Y^2*(S_v))/Z^2 \dots \\
& + (3*S.*Y^2*(S_v))/(exp(4*Z^2)*Z^2) - (4*S.*Y^2*(S_v))/(exp(3*Z^2)*Z^2) + (4*S.*Y^2*(S_v))/(exp(2*Z^2)*Z^2) - (4*S.*Y^2*(S_v))/(exp(Z^2)*Z^2) \dots \\
& - (3*\exp(-3*Z^2 - Y.*Z^2)*S.*Y^2*(S_v))/Z^2 + (4*\exp(-2*Z^2 - Y.*Z^2)*S.*Y^2*(S_v))/Z^2 - (exp(-Z^2 - Y.*Z^2)*S.*Y^2*(S_v))/Z^2 + (3*S^2.*Y^2*(S_v))/(exp(4*Z^2)*Z^2) \dots \\
& - (4*S^2.*Y^2*(S_v))/(exp(3*Z^2)*Z^2) + (S^2.*Y^2*(S_v))/(exp(2*Z^2)*Z^2) - (3*\exp(-3*Z^2 - Y.*Z^2)*S^2.*Y^2*(S_v))/Z^2 + (4*\exp(-2*Z^2 - Y.*Z^2)*S^2.*Y^2*(S_v))/Z^2 \dots \\
& - (exp(-Z^2 - Y.*Z^2)*S^2.*Y^2*(S_v))/Z^2 - (3*S^2*(S_v))/(4*exp(4*Z^2)) - (7*S^2*(S_v))/(4*exp(2*Z^2)) - (3*S^2*(S_v))/(4*exp(4*Z^2)) - (3*S^2*(S_v))/(4*exp(2*Z^2)) \dots \\
& + (2*S.*Y.*Z^2*(S_v))/exp(2*Z^2) + (S^2.*Y.*Z^2*(S_v))/exp(2*Z^2) + (S.*Y^2*(S_v))/exp(3*Z^2) + (3*S.*Y^2*(S_v))/(2*exp(2*Z^2)) + (S^2.*Y^2*(S_v))/exp(3*Z^2) \dots \\
& + (S^2.*Y^2*(S_v))/(2*exp(2*Z^2)) - (2*S.*Y^3*(S_v))/exp(2*Z^2) - (S^2.*Y^3*(S_v))/exp(2*Z^2) + (3*S.*Y^4*(S_v))/(4*exp(4*Z^2)) - (S.*Y^4*(S_v))/exp(3*Z^2) \dots \\
& + (S.*Y^4*(S_v))/(4*exp(2*Z^2)) + (3*S^2.*Y^4*(S_v))/(4*exp(4*Z^2)) - (S^2.*Y^4*(S_v))/exp(3*Z^2) + (S^2.*Y^4*(S_v))/(4*exp(2*Z^2)) + (S^2*(S_v))/(2*exp(3*Z^2)) \dots \\
& + (S^2*(S_v))/(2*exp(3*Z^2)) - (S.*Y^2*(S_v))/exp(3*Z^2) - (S^2.*Y^2*(S_v))/exp(3*Z^2) + (S.*Y^4*(S_v))/(2*exp(3*Z^2)) \dots \\
& + (S^2.*Y^4*(S_v))/(2*exp(3*Z^2)) + (9*S^2*(S_v)^2)/(16*exp(6*Z^2)) - (23*S^2*(S_v)^2)/(8*exp(4*Z^2)) + (2*S^2*(S_v)^2)/exp(3*Z^2) + (S^2*(S_v)^2)/(16*exp(2*Z^2)) \dots \\
& - (exp(-2*Z^2 - 2*Y.*Z^2)*S^2*(S_v)^2)/2 - exp(-3*Z^2 - Y.*Z^2)*S^2*(S_v)^2 - (2*S^2.*Y*(S_v)^2)/exp(3*Z^2) - (S^2.*Y*(S_v)^2)/exp(2*Z^2) + (9*S^2.*Y^2*(S_v)^2)/(8*exp(6*Z^2)) \dots \\
& \dots \\
& - (3*S^2.*Y^2*(S_v)^2)/(2*exp(5*Z^2)) + (11*S^2.*Y^2*(S_v)^2)/(2*exp(4*Z^2)) - (7*S^2.*Y^2*(S_v)^2)/(2*exp(3*Z^2)) + (15*S^2.*Y^2*(S_v)^2)/(8*exp(2*Z^2)) \dots \\
& + (exp(-2*Z^2 - 2*Y.*Z^2)*S^2.*Y^2*(S_v)^2)/2 + exp(-3*Z^2 - Y.*Z^2)*S^2.*Y^2*(S_v)^2 - (3*S^2.*Y^3*(S_v)^2)/exp(4*Z^2) + (4*S^2.*Y^3*(S_v)^2)/exp(3*Z^2) \dots \\
& - (S^2.*Y^3*(S_v)^2)/exp(2*Z^2) + (9*S^2.*Y^4*(S_v)^2)/(16*exp(6*Z^2)) - (3*S^2.*Y^4*(S_v)^2)/(2*exp(5*Z^2)) + (11*S^2.*Y^4*(S_v)^2)/(8*exp(4*Z^2)) \dots \\
& - (S^2.*Y^4*(S_v)^2)/(2*exp(3*Z^2)) + (S^2.*Y^4*(S_v)^2)/(16*exp(2*Z^2)) + (9*S^2*(S_v)^2)/(4*exp(6*Z^2)*Z^2) - (6*S^2*(S_v)^2)/(exp(5*Z^2)*Z^2) \dots \\
& + (11*S^2*(S_v)^2)/(2*exp(4*Z^2)*Z^2) - (2*S^2*(S_v)^2)/(exp(3*Z^2)*Z^2) + (S^2*(S_v)^2)/(4*exp(2*Z^2)*Z^2) + (S^2*(S_v)^2)/(4*exp(2*Y.*Z^2)*Z^2) \dots \\
& + (9*\exp(-4*Z^2 - 2*Y.*Z^2)*S^2*(S_v)^2)/(4*Z^2) - (6*\exp(-3*Z^2 - 2*Y.*Z^2)*S^2*(S_v)^2)/Z^2 + (11*\exp(-2*Z^2 - 2*Y.*Z^2)*S^2*(S_v)^2)/(2*Z^2) \dots \\
& - (2*\exp(-Z^2 - 2*Y.*Z^2)*S^2*(S_v)^2)/Z^2 - (9*\exp(-5*Z^2 - Y.*Z^2)*S^2*(S_v)^2)/(2*Z^2) + (12*\exp(-4*Z^2 - Y.*Z^2)*S^2*(S_v)^2)/Z^2 - (11*\exp(-3*Z^2 - Y.*Z^2)*S^2*(S_v)^2)/Z^2 \dots
\end{aligned}$$

$$\begin{aligned}
& + (4*\exp(-2*Z2 - Y.*Z2)*S^2*(S_v)^2/Z2^4 - (\exp(-Z2 - Y.*Z2)*S^2*(S_v)^2)/(2*Z2^4) + \\
& (12*S^2*(S_v)^2)/(\exp(5*Z2)*Z2^3) - (22*S^2*(S_v)^2)/(\exp(4*Z2)*Z2^3) ... \\
& + (27*S^2*(S_v)^2)/(2*\exp(3*Z2)*Z2^3) - (4*S^2*(S_v)^2)/(\exp(2*Z2)*Z2^3) + \\
& (S^2*(S_v)^2)/(2*\exp(Z2)*Z2^3) - (S^2*(S_v)^2)/(2*\exp(3.*Y.*Z2)*Z2^3) ... \\
& - (S^2*(S_v)^2)/(2*\exp(Y.*Z2)*Z2^3) - (3*\exp(-2*Z2 - 3.*Y.*Z2)*S^2*(S_v)^2)/(2*Z2^3) + (2*\exp(- \\
& Z2 - 3.*Y.*Z2)*S^2*(S_v)^2)/Z2^3 - (3*\exp(-3*Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/(2*Z2^3) ... \\
& + (2*\exp(-2*Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/Z2^3 - (\exp(-Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/(2*Z2^3) - \\
& (9*\exp(-4*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^3 + (18*\exp(-3*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^3 ... \\
& - (25*\exp(-2*Z2 - Y.*Z2)*S^2*(S_v)^2)/(2*Z2^3) + (4*\exp(-Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*\exp(5*Z2)*Z2^3) + (12*S^2.*Y.*(S_v)^2)/(\exp(4*Z2)*Z2^3) ... \\
& - (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z2)*Z2^3) + (4*S^2.*Y.*(S_v)^2)/(\exp(2*Z2)*Z2^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(Z2)*Z2^3) + (S^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z2)*Z2^3) ... \\
& + (9*\exp(-4*Z2 - Y.*Z2)*S^2.*Y.*(S_v)^2)/(2*Z2^3) - (12*\exp(-3*Z2 - \\
& Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2^3 + (11*\exp(-2*Z2 - Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2^3 ... \\
& - (4*\exp(-Z2 - Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2^3 + (S^2*(S_v)^2)/(4*Z2^2) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z2)*Z2^2) - (3*S^2*(S_v)^2)/(\exp(5*Z2)*Z2^2) + \\
& (19*S^2*(S_v)^2)/(\exp(4*Z2)*Z2^2) ... \\
& - (19*S^2*(S_v)^2)/(\exp(3*Z2)*Z2^2) + (35*S^2*(S_v)^2)/(4*\exp(2*Z2)*Z2^2) - \\
& (2*S^2*(S_v)^2)/(\exp(Z2)*Z2^2) + (S^2*(S_v)^2)/(4*\exp(4.*Y.*Z2)*Z2^2) ... \\
& + (S^2*(S_v)^2)/(2*\exp(2.*Y.*Z2)*Z2^2) + (\exp(-Z2 - 3.*Y.*Z2)*S^2*(S_v)^2)/Z2^2 + (5*\exp(-2*Z2 \\
& - 2.*Y.*Z2)*S^2*(S_v)^2)/Z2^2 - (2*\exp(-Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/Z2^2 ... \\
& - (9*\exp(-5*Z2 - Y.*Z2)*S^2*(S_v)^2)/(4*Z2^2) + (3*\exp(-4*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^2 + \\
& (5*\exp(-3*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^2 - (\exp(-2*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2^2 ... \\
& + (\exp(-Z2 - Y.*Z2)*S^2*(S_v)^2)/(4*Z2^2) - (S^2.*Y.*(S_v)^2)/(2*Z2^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(\exp(4*Z2)*Z2^2) + (26*S^2.*Y.*(S_v)^2)/(\exp(3*Z2)*Z2^2) ... \\
& - (29*S^2.*Y.*(S_v)^2)/(2*\exp(2*Z2)*Z2^2) + (4*S^2.*Y.*(S_v)^2)/(\exp(Z2)*Z2^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z2)*Z2^2) - (3*\exp(-2*Z2 - 2.*Y.*Z2)*S^2.*Y.*(S_v)^2)/(2*Z2^2) ... \\
& + (2*\exp(-Z2 - 2.*Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z2^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z2)*Z2^2) - (6*S^2.*Y.^2*(S_v)^2)/(\exp(5*Z2)*Z2^2) ... \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z2)*Z2^2) - (8*S^2.*Y.^2*(S_v)^2)/(\exp(3*Z2)*Z2^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z2)*Z2^2) - (2*S^2.*Y.^2*(S_v)^2)/(\exp(Z2)*Z2^2) ... \\
& - (9*\exp(-5*Z2 - Y.*Z2)*S^2.*Y.^2*(S_v)^2)/(4*Z2^2) + (6*\exp(-4*Z2 - \\
& Y.*Z2)*S^2.*Y.^2*(S_v)^2)/Z2^2 - (11*\exp(-3*Z2 - Y.*Z2)*S^2.*Y.^2*(S_v)^2)/(2*Z2^2) ... \\
& + (2*\exp(-2*Z2 - Y.*Z2)*S^2.*Y.^2*(S_v)^2)/Z2^2 - (\exp(-Z2 - Y.*Z2)*S^2.*Y.^2*(S_v)^2)/(4*Z2^2) \\
& + (9*S^2*(S_v)^2)/(2*\exp(5*Z2)*Z2) - (S^2*(S_v)^2)/(\exp(4*Z2)*Z2) ... \\
& + (25*S^2*(S_v)^2)/(4*\exp(3*Z2)*Z2) - (3*S^2*(S_v)^2)/(\exp(2*Z2)*Z2) + \\
& (3*S^2*(S_v)^2)/(4*\exp(Z2)*Z2) + (3*\exp(-3*Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/(4*Z2) ... \\
& + (3*\exp(-Z2 - 2.*Y.*Z2)*S^2*(S_v)^2)/(4*Z2) + (3*\exp(-4*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2 - (2*\exp(- \\
& 3*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2 + (2*\exp(-2*Z2 - Y.*Z2)*S^2*(S_v)^2)/Z2 ... \\
& - (9*S^2.*Y.*(S_v)^2)/(4*\exp(5*Z2)*Z2) + (3*S^2.*Y.*(S_v)^2)/(\exp(4*Z2)*Z2) - \\
& (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z2)*Z2) + (7*S^2.*Y.*(S_v)^2)/(\exp(2*Z2)*Z2) ... \\
& - (7*S^2.*Y.*(S_v)^2)/(4*\exp(Z2)*Z2) - (\exp(-Z2 - 2.*Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2 - (2*\exp(-2*Z2 - \\
& Y.*Z2)*S^2.*Y.*(S_v)^2)/Z2 + (15*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z2)*Z2) ... \\
& - (13*S^2.*Y.^2*(S_v)^2)/(\exp(4*Z2)*Z2) + (41*S^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z2)*Z2) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(\exp(2*Z2)*Z2) + (5*S^2.*Y.^2*(S_v)^2)/(4*\exp(Z2)*Z2) ... \\
& + (3*\exp(-3*Z2 - 2.*Y.*Z2)*S^2.*Y.^2*(S_v)^2)/(4*Z2) - (\exp(-2*Z2 - \\
& 2.*Y.*Z2)*S^2.*Y.^2*(S_v)^2)/Z2 + (\exp(-Z2 - 2.*Y.*Z2)*S^2.*Y.^2*(S_v)^2)/(4*Z2) ... \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z2)*Z2) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z2)*Z2) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z2)*Z2) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z2)*Z2) ... \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z2)*Z2) - (3*S^2*Z2*(S_v)^2)/(4*\exp(5*Z2)) - \\
& (3*S^2*Z2*(S_v)^2)/(4*\exp(3*Z2)) + (S^2.*Y.*Z2*(S_v)^2)/\exp(3*Z2) + \\
& (S^2.*Y.^2*Z2*(S_v)^2)/\exp(4*Z2) ... \\
& + (S^2.*Y.^2*Z2*(S_v)^2)/(2*\exp(3*Z2)) - (S^2.*Y.^3*Z2*(S_v)^2)/\exp(3*Z2) + \\
& (3*S^2.*Y.^4*Z2*(S_v)^2)/(4*\exp(5*Z2)) - (S^2.*Y.^4*Z2*(S_v)^2)/\exp(4*Z2) ... \\
& + (S^2.*Y.^4*Z2*(S_v)^2)/(4*\exp(3*Z2)) + (S^2*Z2^2*(S_v)^2)/(4*\exp(4*Z2)) - \\
& (S^2.*Y.^2*Z2^2*(S_v)^2)/(2*\exp(4*Z2)) + (S^2.*Y.^4*Z2^2*(S_v)^2)/(4*\exp(4*Z2));
\end{aligned}$$

$Ns2=Nf2+Nc+Ny2;$
 $\Phi2=Nf2./[Nc+Ny2];$
 $Be2=1./[1+\Phi2];$
 $Gf2=Nf2./Ns2;$
 $Gh2=[Nc+Ny2]./Ns2;$
 $Nh2=Nc+Ny2;$

$Z3=10;$
 $Nf3=Br*[(Z3^2).exp(-2.*Y.*Z3)+(Z3^2)*exp(-2*Z3)-2*Z3^2.*exp(-Z3-Y.*Z3)];$
 $Ny3=1 - exp(-2*Z3) + exp(-Z3 - Y.*Z3) - (2*S)/exp(2*Z3) + 2*exp(-Z3 - Y.*Z3)*S - S^2/exp(2*Z3) +$
 $exp(-Z3 - Y.*Z3)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z3) - exp(-Z3 - Y.*Z3).*Y.^2 ...$
 $+ (2*S.*Y.^2)/exp(2*Z3) - 2*exp(-Z3 - Y.*Z3)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z3) - exp(-Z3 -$
 $Y.*Z3)*S^2.*Y.^2 + 1/(exp(2*Z3)*Z3^2) + 1./(exp(2.*Y.*Z3)*Z3^2) ...$
 $- (2*exp(-Z3 - Y.*Z3))/Z3^2 + (2*S)/(exp(2*Z3)*Z3^2) + (2*S)/(exp(2.*Y.*Z3)*Z3^2) - (4*exp(-Z3 -$
 $Y.*Z3)*S)/Z3^2 + S^2/(exp(2*Z3)*Z3^2) + S^2/(exp(2.*Y.*Z3)*Z3^2) ...$
 $- (2*exp(-Z3 - Y.*Z3)*S^2)/Z3^2 + 2/(exp(Z3)*Z3) - 2./(exp(Y.*Z3)*Z3) + (2*S)/(exp(Z3)*Z3) -$
 $(2*S)/(exp(Y.*Z3)*Z3) - (2.*Y)/(exp(Z3)*Z3) + (2.*Y)/(exp(Y.*Z3)*Z3) ...$
 $- (2*S.*Y)/(exp(Z3)*Z3) + (2*S.*Y)/(exp(Y.*Z3)*Z3) - Z3/exp(Z3) - (S*Z3)/exp(Z3) +$
 $(Y.*Z3)/exp(Z3) + (S.*Y.*Z3)/exp(Z3) + (Y.^2*Z3)/exp(Z3) + (S.*Y.^2*Z3)/exp(Z3) - (Y.^3*Z3)/exp(Z3)$
 $...$
 $- (S.*Y.^3*Z3)/exp(Z3) + Z3^2/(4*exp(2*Z3)) + (S*Z3^2)/(2*exp(2*Z3)) + (S^2*Z3^2)/(4*exp(2*Z3))$
 $- (Y.^2*Z3^2)/(2*exp(2*Z3)) - (S.*Y.^2*Z3^2)/exp(2*Z3) ...$
 $- (S^2.*Y.^2*Z3^2)/(2*exp(2*Z3)) + (Y.^4*Z3^2)/(4*exp(2*Z3)) + (S.*Y.^4*Z3^2)/(2*exp(2*Z3)) +$
 $(S^2.*Y.^4*Z3^2)/(4*exp(2*Z3)) - (7*S*(S_v))/(2*exp(3*Z3)) ...$
 $+ (2*S*(S_v))/exp(2*Z3) + (S*(S_v))/exp(Z3) - (exp(-Z3 - 2.*Y.*Z3)*S*(S_v))/2 -$
 $(5*S^2*(S_v))/exp(3*Z3) + (2*S^2*(S_v))/exp(2*Z3) - (S^2*(S_v))/(2*exp(Z3)) ...$
 $- (exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v))/2 - (2*S.*Y.*(S_v))/exp(2*Z3) - (3*S.*Y.*(S_v))/exp(Z3) +$
 $(3*S^2.*Y.*(S_v))/(2*exp(3*Z3)) - (2*S^2.*Y.*(S_v))/exp(2*Z3) ...$
 $+ (S^2.*Y.*(S_v))/(2*exp(Z3)) + (13*S.*Y.^2*(S_v))/(2*exp(3*Z3)) - (4*S.*Y.^2*(S_v))/exp(2*Z3) +$
 $(3*S.*Y.^2*(S_v))/exp(Z3) + (exp(-Z3 - 2.*Y.*Z3)*S.*Y.^2*(S_v))/2 ...$
 $+ (5*S^2.*Y.^2*(S_v))/exp(3*Z3) - (2*S^2.*Y.^2*(S_v))/exp(2*Z3) + (S^2.*Y.^2*(S_v))/(2*exp(Z3))$
 $+ (exp(-Z3 - 2.*Y.*Z3)*S^2.*Y.^2*(S_v))/2 - (3*S.*Y.^3*(S_v))/exp(3*Z3) ...$
 $+ (4*S.*Y.^3*(S_v))/exp(2*Z3) - (S.*Y.^3*(S_v))/exp(Z3) - (3*S^2.*Y.^3*(S_v))/(2*exp(3*Z3)) +$
 $(2*S^2.*Y.^3*(S_v))/exp(2*Z3) - (S^2.*Y.^3*(S_v))/(2*exp(Z3)) ...$
 $+ (3*S*(S_v))/(exp(4*Z3)*Z3^3) - (4*S*(S_v))/(exp(3*Z3)*Z3^3) + (S*(S_v))/(exp(2*Z3)*Z3^3) +$
 $(S*(S_v))/(exp(2.*Y.*Z3)*Z3^3) + (3*exp(-2*Z3 - 2.*Y.*Z3)*S*(S_v))/Z3^3 ...$
 $- (4*exp(-Z3 - 2.*Y.*Z3)*S*(S_v))/Z3^3 - (6*exp(-3*Z3 - Y.*Z3)*S*(S_v))/Z3^3 + (8*exp(-2*Z3 -$
 $Y.*Z3)*S*(S_v))/Z3^3 - (2*exp(-Z3 - Y.*Z3)*S*(S_v))/Z3^3 ...$
 $+ (3*S^2*(S_v))/(exp(4*Z3)*Z3^3) - (4*S^2*(S_v))/(exp(3*Z3)*Z3^3) +$
 $(S^2*(S_v))/(exp(2*Z3)*Z3^3) + (S^2*(S_v))/(exp(2.*Y.*Z3)*Z3^3) + (3*exp(-2*Z3 -$
 $2.*Y.*Z3)*S^2*(S_v))/Z3^3 ...$
 $- (4*exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v))/Z3^3 - (6*exp(-3*Z3 - Y.*Z3)*S^2*(S_v))/Z3^3 + (8*exp(-2*Z3$
 $- Y.*Z3)*S^2*(S_v))/Z3^3 - (2*exp(-Z3 - Y.*Z3)*S^2*(S_v))/Z3^3 ...$
 $+ (11*S*(S_v))/(exp(3*Z3)*Z3^2) - (8*S*(S_v))/(exp(2*Z3)*Z3^2) + (2*S*(S_v))/(exp(Z3)*Z3^2) -$
 $(S*(S_v))/(exp(3.*Y.*Z3)*Z3^2) - (2*S*(S_v))/(exp(Y.*Z3)*Z3^2) ...$
 $- (exp(-Z3 - 2.*Y.*Z3)*S*(S_v))/Z3^2 - (9*exp(-2*Z3 - Y.*Z3)*S*(S_v))/Z3^2 + (8*exp(-Z3 -$
 $Y.*Z3)*S*(S_v))/Z3^2 + (8*S^2*(S_v))/(exp(3*Z3)*Z3^2); ...$
 $- (4*S^2*(S_v))/(exp(2*Z3)*Z3^2) + (S^2*(S_v))/(exp(Z3)*Z3^2) -$
 $(S^2*(S_v))/(exp(3.*Y.*Z3)*Z3^2) - (S^2*(S_v))/(exp(Y.*Z3)*Z3^2) - (exp(-Z3 -$
 $2.*Y.*Z3)*S^2*(S_v))/Z3^2 ...$
 $- (6*exp(-2*Z3 - Y.*Z3)*S^2*(S_v))/Z3^2 + (4*exp(-Z3 - Y.*Z3)*S^2*(S_v))/Z3^2 -$
 $(6*S.*Y.*(S_v))/(exp(3*Z3)*Z3^2) + (8*S.*Y.*(S_v))/(exp(2*Z3)*Z3^2) ...$
 $- (2*S.*Y.*(S_v))/(exp(Z3)*Z3^2) + (2*S.*Y.*(S_v))/(exp(Y.*Z3)*Z3^2) + (6*exp(-2*Z3 -$
 $Y.*Z3)*S.*Y.*(S_v))/Z3^2 - (8*exp(-Z3 - Y.*Z3)*S.*Y.*(S_v))/Z3^2 ...$

$$\begin{aligned}
& - \frac{(3*S^2.*Y.*(S_v))}{(\exp(3*Z3)*Z3^2)} + \frac{(4*S^2.*Y.*(S_v))}{(\exp(2*Z3)*Z3^2)} - \\
& (S^2.*Y.*(S_v))/(\exp(Z3)*Z3^2) + (S^2.*Y.*(S_v))/(\exp(Y.*Z3)*Z3^2) \dots \\
& + \frac{(3*\exp(-2*Z3 - Y.*Z3)*S^2.*Y.*(S_v))}{Z3^2} - \frac{(4*\exp(-Z3 - Y.*Z3)*S^2.*Y.*(S_v))}{Z3^2} + \\
& (S*(S_v))/Z3 + \frac{(2*S*(S_v))}{(\exp(3*Z3)*Z3)} + \frac{(9*S*(S_v))}{(\exp(2*Z3)*Z3)} \dots \\
& - \frac{(4*S*(S_v))}{(\exp(Z3)*Z3)} + \frac{(S*(S_v))}{(\exp(2.*Y.*Z3)*Z3)} - \frac{(2*\exp(-2*Z3 - Y.*Z3)*S*(S_v))}{Z3} + \\
& \frac{(\exp(-Z3 - Y.*Z3)*S*(S_v))}{Z3} + \frac{(2*S^2*(S_v))}{(\exp(3*Z3)*Z3)} \dots \\
& + \frac{(S^2*(S_v))}{(\exp(2*Z3)*Z3)} - \frac{(2*\exp(-2*Z3 - Y.*Z3)*S^2*(S_v))}{Z3} - \frac{(\exp(-Z3 - Y.*Z3)*S^2*(S_v))}{Z3} - \frac{(2*S.*Y.*(S_v))}{Z3} - \frac{(13*S.*Y.*(S_v))}{(\exp(2*Z3)*Z3)} \dots \\
& + \frac{(8*S.*Y.*(S_v))}{(\exp(Z3)*Z3)} - \frac{(S.*Y.*(S_v))}{(\exp(2.*Y.*Z3)*Z3)} - \\
& \frac{(2*S^2.*Y.*(S_v))}{(\exp(2*Z3)*Z3)} + \frac{(2*\exp(-Z3 - Y.*Z3)*S^2.*Y.*(S_v))}{Z3} + \frac{(S.*Y.^2*(S_v))}{Z3} \dots \\
& + \frac{(3*S.*Y.^2*(S_v))}{(\exp(4*Z3)*Z3)} - \frac{(4*S.*Y.^2*(S_v))}{(\exp(3*Z3)*Z3)} + \\
& \frac{(4*S.*Y.^2*(S_v))}{(\exp(2*Z3)*Z3)} - \frac{(4*S.*Y.^2*(S_v))}{(\exp(Z3)*Z3)} \dots \\
& - \frac{(3*\exp(-3*Z3 - Y.*Z3)*S.*Y.^2*(S_v))}{Z3} + \frac{(4*\exp(-2*Z3 - Y.*Z3)*S.*Y.^2*(S_v))}{Z3} - \frac{(\exp(-Z3 - Y.*Z3)*S.*Y.^2*(S_v))}{Z3} + \frac{(3*S^2.*Y.^2*(S_v))}{(\exp(4*Z3)*Z3)} \dots \\
& - \frac{(4*S^2.*Y.^2*(S_v))}{(\exp(3*Z3)*Z3)} + \frac{(S^2.*Y.^2*(S_v))}{(\exp(2*Z3)*Z3)} - \frac{(3*\exp(-3*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v))}{Z3} + \frac{(4*\exp(-2*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v))}{Z3} \dots \\
& - \frac{(\exp(-Z3 - Y.*Z3)*S^2.*Y.^2*(S_v))}{Z3} - \frac{(3*S^2*Z3*(S_v))}{(\exp(4*Z3))} - \\
& \frac{(7*S^2*Z3*(S_v))}{(4*\exp(2*Z3))} - \frac{(3*S^2*Z3*(S_v))}{(4*\exp(4*Z3))} - \frac{(3*S^2*Z3*(S_v))}{(4*\exp(2*Z3))} \dots \\
& + \frac{(2*S.*Y.*Z3*(S_v))}{\exp(2*Z3)} + \frac{(S^2.*Y.*Z3*(S_v))}{\exp(2*Z3)} + \frac{(S.*Y.^2*Z3*(S_v))}{\exp(3*Z3)} + \\
& \frac{(3*S.*Y.^2*Z3*(S_v))}{(2*\exp(2*Z3))} + \frac{(S^2.*Y.^2*Z3*(S_v))}{\exp(3*Z3)} \dots \\
& + \frac{(S^2.*Y.^2*Z3*(S_v))}{(2*\exp(2*Z3))} - \frac{(2*S.*Y.^3*Z3*(S_v))}{\exp(2*Z3)} - \\
& \frac{(S^2.*Y.^3*Z3*(S_v))}{\exp(2*Z3)} + \frac{(3*S.*Y.^4*Z3*(S_v))}{(4*\exp(4*Z3))} - \\
& \frac{(S.*Y.^4*Z3*(S_v))}{\exp(3*Z3)} \dots \\
& + \frac{(S.*Y.^4*Z3*(S_v))}{(4*\exp(2*Z3))} + \frac{(3*S^2.*Y.^4*Z3*(S_v))}{(4*\exp(4*Z3))} - \\
& \frac{(S^2.*Y.^4*Z3*(S_v))}{\exp(3*Z3)} + \frac{(S^2.*Y.^4*Z3*(S_v))}{(4*\exp(2*Z3))} + \\
& \frac{(S*Z3^2*(S_v))}{(2*\exp(3*Z3))} \dots \\
& + \frac{(S^2*Z3^2*(S_v))}{(2*\exp(3*Z3))} - \frac{(S.*Y.^2*Z3^2*(S_v))}{\exp(3*Z3)} - \\
& \frac{(S^2.*Y.^2*Z3^2*(S_v))}{\exp(3*Z3)} + \frac{(S.*Y.^4*Z3^2*(S_v))}{(2*\exp(3*Z3))} \dots \\
& + \frac{(S^2.*Y.^4*Z3^2*(S_v))}{(2*\exp(3*Z3))} + \frac{(9*S^2*(S_v)^2)}{(16*\exp(6*Z3))} - \\
& \frac{(23*S^2*(S_v)^2)}{(8*\exp(4*Z3))} + \frac{(2*S^2*(S_v)^2)}{\exp(3*Z3)} + \frac{(S^2*(S_v)^2)}{(16*\exp(2*Z3))} \dots \\
& - \frac{(\exp(-2*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{2} - \frac{\exp(-3*Z3 - Y.*Z3)*S^2*(S_v)^2}{2} - \\
& \frac{(2*S^2.*Y.*(S_v)^2)}{\exp(3*Z3)} - \frac{(S^2.*Y.*(S_v)^2)}{\exp(2*Z3)} + \frac{(9*S^2.*Y.^2*(S_v)^2)}{(8*\exp(6*Z3))} \\
& \dots \\
& - \frac{(3*S^2.*Y.^2*(S_v)^2)}{(2*\exp(5*Z3))} + \frac{(11*S^2.*Y.^2*(S_v)^2)}{(2*\exp(4*Z3))} - \\
& \frac{(7*S^2.*Y.^2*(S_v)^2)}{(2*\exp(3*Z3))} + \frac{(15*S^2.*Y.^2*(S_v)^2)}{(8*\exp(2*Z3))} \dots \\
& + \frac{(\exp(-2*Z3 - 2.*Y.*Z3)*S^2.*Y.^2*(S_v)^2)}{2} + \frac{\exp(-3*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v)^2}{2} - \\
& \frac{(3*S^2.*Y.^3*(S_v)^2)}{\exp(4*Z3)} + \frac{(4*S^2.*Y.^3*(S_v)^2)}{\exp(3*Z3)} \dots \\
& - \frac{(S^2.*Y.^3*(S_v)^2)}{\exp(2*Z3)} + \frac{(9*S^2.*Y.^4*(S_v)^2)}{(16*\exp(6*Z3))} - \\
& \frac{(3*S^2.*Y.^4*(S_v)^2)}{(2*\exp(5*Z3))} + \frac{(11*S^2.*Y.^4*(S_v)^2)}{(8*\exp(4*Z3))} \dots \\
& - \frac{(S^2.*Y.^4*(S_v)^2)}{(2*\exp(3*Z3))} + \frac{(S^2.*Y.^4*(S_v)^2)}{(16*\exp(2*Z3))} + \\
& \frac{(9*S^2*(S_v)^2)}{(4*\exp(6*Z3)*Z3^4)} - \frac{(6*S^2*(S_v)^2)}{(\exp(5*Z3)*Z3^4)} \dots \\
& + \frac{(11*S^2*(S_v)^2)}{(2*\exp(4*Z3)*Z3^4)} - \frac{(2*S^2*(S_v)^2)}{(\exp(3*Z3)*Z3^4)} + \\
& \frac{(S^2*(S_v)^2)}{(4*\exp(2*Z3)*Z3^4)} + \frac{(S^2*(S_v)^2)}{(4*\exp(2.*Y.*Z3)*Z3^4)} \dots \\
& + \frac{(9*\exp(-4*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{(4*Z3^4)} - \frac{(6*\exp(-3*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{Z3^4} + \\
& \frac{(11*\exp(-2*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^4)} \dots \\
& - \frac{(2*\exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{Z3^4} - \frac{(9*\exp(-5*Z3 - Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^4)} + \\
& \frac{(12*\exp(-4*Z3 - Y.*Z3)*S^2*(S_v)^2)}{Z3^4} - \frac{(11*\exp(-3*Z3 - Y.*Z3)*S^2*(S_v)^2)}{Z3^4} \dots \\
& + \frac{(4*\exp(-2*Z3 - Y.*Z3)*S^2*(S_v)^2)}{Z3^4} - \frac{(\exp(-Z3 - Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^4)} + \\
& \frac{(12*S^2*(S_v)^2)}{(\exp(5*Z3)*Z3^3)} - \frac{(22*S^2*(S_v)^2)}{(\exp(4*Z3)*Z3^3)} \dots \\
& + \frac{(27*S^2*(S_v)^2)}{(2*\exp(3*Z3)*Z3^3)} - \frac{(4*S^2*(S_v)^2)}{(\exp(2*Z3)*Z3^3)} + \\
& \frac{(S^2*(S_v)^2)}{(2*\exp(Z3)*Z3^3)} - \frac{(S^2*(S_v)^2)}{(2*\exp(3.*Y.*Z3)*Z3^3)} \dots \\
& - \frac{(S^2*(S_v)^2)}{(2*\exp(Y.*Z3)*Z3^3)} - \frac{(3*\exp(-2*Z3 - 3.*Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^3)} + \frac{(2*\exp(-Z3 - 3.*Y.*Z3)*S^2*(S_v)^2)}{Z3^3} - \frac{(3*\exp(-3*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^3)} \dots \\
& + \frac{(2*\exp(-2*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{Z3^3} - \frac{(\exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)}{(2*Z3^3)} - \\
& \frac{(9*\exp(-4*Z3 - Y.*Z3)*S^2*(S_v)^2)}{Z3^3} + \frac{(18*\exp(-3*Z3 - Y.*Z3)*S^2*(S_v)^2)}{Z3^3} \dots
\end{aligned}$$

$$\begin{aligned}
& - (25*\exp(-2*Z3 - Y.*Z3)*S^2*(S_v)^2)/(2*Z3^3) + (4*\exp(-Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*\exp(5*Z3)*Z3^3) + (12*S^2.*Y.*(S_v)^2)/(\exp(4*Z3)*Z3^3) ... \\
& - (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z3)*Z3^3) + (4*S^2.*Y.*(S_v)^2)/(\exp(2*Z3)*Z3^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(Z3)*Z3^3) + (S^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z3)*Z3^3) ... \\
& + (9*\exp(-4*Z3 - Y.*Z3)*S^2.*Y.*(S_v)^2)/(2*Z3^3) - (12*\exp(-3*Z3 - \\
& Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3^3 + (11*\exp(-2*Z3 - Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3^3 ... \\
& - (4*\exp(-Z3 - Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3^3 + (S^2*(S_v)^2)/(4*Z3^2) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z3)*Z3^2) - (3*S^2*(S_v)^2)/(\exp(5*Z3)*Z3^2) + \\
& (19*S^2*(S_v)^2)/(\exp(4*Z3)*Z3^2) ... \\
& - (19*S^2*(S_v)^2)/(\exp(3*Z3)*Z3^2) + (35*S^2*(S_v)^2)/(4*\exp(2*Z3)*Z3^2) - \\
& (2*S^2*(S_v)^2)/(\exp(Z3)*Z3^2) + (S^2*(S_v)^2)/(4*\exp(4.*Y.*Z3)*Z3^2) ... \\
& + (S^2*(S_v)^2)/(2*\exp(2.*Y.*Z3)*Z3^2) + (\exp(-Z3 - 3.*Y.*Z3)*S^2*(S_v)^2)/Z3^2 + (5*\exp(-2*Z3 - \\
& 2.*Y.*Z3)*S^2*(S_v)^2)/Z3^2 - (2*\exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)/Z3^2 ... \\
& - (9*\exp(-5*Z3 - Y.*Z3)*S^2*(S_v)^2)/(4*Z3^2) + (3*\exp(-4*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3^2 + \\
& (5*\exp(-3*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3^2 - (\exp(-2*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3^2 ... \\
& + (\exp(-Z3 - Y.*Z3)*S^2*(S_v)^2)/(4*Z3^2) - (S^2.*Y.*(S_v)^2)/(2*Z3^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(\exp(4*Z3)*Z3^2) + (26*S^2.*Y.*(S_v)^2)/(\exp(3*Z3)*Z3^2) ... \\
& - (29*S^2.*Y.*(S_v)^2)/(2*\exp(2*Z3)*Z3^2) + (4*S^2.*Y.*(S_v)^2)/(\exp(Z3)*Z3^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z3)*Z3^2) - (3*\exp(-2*Z3 - 2.*Y.*Z3)*S^2.*Y.*(S_v)^2)/(2*Z3^2) ... \\
& + (2*\exp(-Z3 - 2.*Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z3^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z3)*Z3^2) - (6*S^2.*Y.^2*(S_v)^2)/(\exp(5*Z3)*Z3^2) ... \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z3)*Z3^2) - (8*S^2.*Y.^2*(S_v)^2)/(\exp(3*Z3)*Z3^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z3)*Z3^2) - (2*S^2.*Y.^2*(S_v)^2)/(\exp(Z3)*Z3^2) ... \\
& - (9*\exp(-5*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v)^2)/(4*Z3^2) + (6*\exp(-4*Z3 - \\
& Y.*Z3)*S^2.*Y.^2*(S_v)^2)/Z3^2 - (11*\exp(-3*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v)^2)/(2*Z3^2) ... \\
& + (2*\exp(-2*Z3 - Y.*Z3)*S^2.*Y.^2*(S_v)^2)/Z3^2 - (\exp(-Z3 - Y.*Z3)*S^2.*Y.^2*(S_v)^2)/(4*Z3^2) \\
& + (9*S^2*(S_v)^2)/(2*\exp(5*Z3)*Z3) - (S^2*(S_v)^2)/(\exp(4*Z3)*Z3) ... \\
& + (25*S^2*(S_v)^2)/(4*\exp(3*Z3)*Z3) - (3*S^2*(S_v)^2)/(\exp(2*Z3)*Z3) + \\
& (3*S^2*(S_v)^2)/(4*\exp(Z3)*Z3) + (3*\exp(-3*Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)/(4*Z3) ... \\
& + (3*\exp(-Z3 - 2.*Y.*Z3)*S^2*(S_v)^2)/(4*Z3) + (3*\exp(-4*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3 - (2*\exp(- \\
& 3*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3 + (2*\exp(-2*Z3 - Y.*Z3)*S^2*(S_v)^2)/Z3 ... \\
& - (9*S^2.*Y.*(S_v)^2)/(4*\exp(5*Z3)*Z3) + (3*S^2.*Y.*(S_v)^2)/(\exp(4*Z3)*Z3) - \\
& (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z3)*Z3) + (7*S^2.*Y.*(S_v)^2)/(\exp(2*Z3)*Z3) ... \\
& - (7*S^2.*Y.*(S_v)^2)/(4*\exp(Z3)*Z3) - (\exp(-Z3 - 2.*Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3 - (2*\exp(-2*Z3 - \\
& Y.*Z3)*S^2.*Y.*(S_v)^2)/Z3 + (15*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z3)*Z3) ... \\
& - (13*S^2.*Y.^2*(S_v)^2)/(\exp(4*Z3)*Z3) + (41*S^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z3)*Z3) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(\exp(2*Z3)*Z3) + (5*S^2.*Y.^2*(S_v)^2)/(4*\exp(Z3)*Z3) ... \\
& + (3*\exp(-3*Z3 - 2.*Y.*Z3)*S^2.*Y.^2*(S_v)^2)/(4*Z3) - (\exp(-2*Z3 - \\
& 2.*Y.*Z3)*S^2.*Y.^2*(S_v)^2)/Z3 + (\exp(-Z3 - 2.*Y.*Z3)*S^2.*Y.^2*(S_v)^2)/(4*Z3) ... \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z3)*Z3) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z3)*Z3) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z3)*Z3) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z3)*Z3) ... \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z3)*Z3) - (3*S^2*Z3*(S_v)^2)/(4*\exp(5*Z3)) - \\
& (3*S^2*Z3*(S_v)^2)/(4*\exp(3*Z3)) + (S^2.*Y.*Z3*(S_v)^2)/\exp(3*Z3) + \\
& (S^2.*Y.^2*Z3*(S_v)^2)/\exp(4*Z3) ... \\
& + (S^2.*Y.^2*Z3*(S_v)^2)/(2*\exp(3*Z3)) - (S^2.*Y.^3*Z3*(S_v)^2)/\exp(3*Z3) + \\
& (3*S^2.*Y.^4*Z3*(S_v)^2)/(4*\exp(5*Z3)) - (S^2.*Y.^4*Z3*(S_v)^2)/\exp(4*Z3) ... \\
& + (S^2.*Y.^4*Z3*(S_v)^2)/(4*\exp(3*Z3)) + (S^2*Z3^2*(S_v)^2)/(4*\exp(4*Z3)) - \\
& (S^2.*Y.^2*Z3^2*(S_v)^2)/(2*\exp(4*Z3)) + (S^2.*Y.^4*Z3^2*(S_v)^2)/(4*\exp(4*Z3));
\end{aligned}$$

$$\begin{aligned}
Ns3 &= Nf3 + Nc + Ny3; \\
Phi3 &= Nf3./[Nc + Ny3]; \\
Be3 &= 1./[1 + Phi3]; \\
Gf3 &= Nf3./Ns3; \\
Gh3 &= [Nc + Ny3]./Ns3; \\
Nh3 &= Nc + Ny3;
\end{aligned}$$

$Z4=12.5;$
 $Nf4=Br*[(Z4^2).exp(-2.*Y.*Z4)+(Z4^2).exp(-2*Z4^2).exp(-Z4-Y.*Z4)];$
 $Ny4=1-exp(-2*Z4)+exp(-Z4-Y.*Z4)-(2*S)/exp(2*Z4)+2*exp(-Z4-Y.*Z4)*S-S^2/exp(2*Z4)+$
 $exp(-Z4-Y.*Z4)*S^2-2.*Y+Y.^2+Y.^2/exp(2*Z4)-exp(-Z4-Y.*Z4).*Y.^2...$
 $+ (2*S.*Y.^2)/exp(2*Z4)-2*exp(-Z4-Y.*Z4)*S.*Y.^2+(S^2.*Y.^2)/exp(2*Z4)-exp(-Z4-Y.*Z4)*S^2.*Y.^2+1/(exp(2*Z4)*Z4^2)+1./(exp(2.*Y.*Z4)*Z4^2)...$
 $-(2*exp(-Z4-Y.*Z4))/Z4^2+(2*S)/(exp(2*Z4)*Z4^2)+(2*S)/(exp(2.*Y.*Z4)*Z4^2)-(4*exp(-Z4-Y.*Z4)*S)/Z4^2+S^2/(exp(2*Z4)*Z4^2)+S^2./(exp(2.*Y.*Z4)*Z4^2)...$
 $-(2*exp(-Z4-Y.*Z4)*S^2)/Z4^2+2/(exp(Z4)*Z4)-2./(exp(Y.*Z4)*Z4)+(2*S)/(exp(Z4)*Z4)-(2*S)/(exp(Y.*Z4)*Z4)-(2.*Y)/(exp(Z4)*Z4)+(2.*Y)/(exp(Y.*Z4)*Z4)...$
 $-(2*S.*Y)/(exp(Z4)*Z4)+(2*S.*Y)/(exp(Y.*Z4)*Z4)-Z4/exp(Z4)-(S*Z4)/exp(Z4)+(Y.*Z4)/exp(Z4)+(S.*Y.*Z4)/exp(Z4)+(Y.^2*Z4)/exp(Z4)+(S.*Y.^2*Z4)/exp(Z4)-(Y.^3*Z4)/exp(Z4)$
 $...$
 $-(S.*Y.^3*Z4)/exp(Z4)+Z4^2/(4*exp(2*Z4))+(S*Z4^2)/(2*exp(2*Z4))+(S^2*Z4^2)/(4*exp(2*Z4))$
 $-(Y.^2*Z4^2)/(2*exp(2*Z4))-(S.*Y.^2*Z4^2)/exp(2*Z4)...$
 $-(S^2.*Y.^4*Z4^2)/(2*exp(2*Z4))+(Y.^4*Z4^2)/(4*exp(2*Z4))+(S.*Y.^4*Z4^2)/(2*exp(2*Z4))+$
 $(S^2.*Y.^4*Z4^2)/(4*exp(2*Z4))-(7*S*(S_v))/(2*exp(3*Z4))...$
 $+(2*S*(S_v))/exp(2*Z4)+(S*(S_v))/exp(Z4)-(exp(-Z4-2.*Y.*Z4)*S*(S_v))/2-$
 $(5*S^2*(S_v))/exp(3*Z4)+(2*S^2*(S_v))/exp(2*Z4)-(S^2*(S_v))/(2*exp(Z4))...$
 $-(exp(-Z4-2.*Y.*Z4)*S^2*(S_v))/2-(2*S.*Y*(S_v))/exp(2*Z4)-(3*S.*Y*(S_v))/exp(Z4)+$
 $(3*S^2.*Y*(S_v))/(2*exp(3*Z4))-(2*S^2.*Y*(S_v))/exp(2*Z4)...$
 $+(S^2.*Y*(S_v))/(2*exp(Z4))+(13*S.*Y.^2*(S_v))/(2*exp(3*Z4))-(4*S.*Y.^2*(S_v))/exp(2*Z4)+$
 $(3*S.*Y.^2*(S_v))/exp(Z4)+(exp(-Z4-2.*Y.*Z4)*S.*Y.^2*(S_v))/2...$
 $+(5*S^2.*Y.^2*(S_v))/exp(3*Z4)-(2*S^2.*Y.^2*(S_v))/exp(2*Z4)+(S^2.*Y.^2*(S_v))/(2*exp(Z4))$
 $+(exp(-Z4-2.*Y.*Z4)*S^2.*Y.^2*(S_v))/2-(3*S.*Y.^3*(S_v))/exp(3*Z4)...$
 $+(4*S.*Y.^3*(S_v))/exp(2*Z4)-(S.*Y.^3*(S_v))/exp(Z4)-(3*S^2.*Y.^3*(S_v))/(2*exp(3*Z4))+$
 $(2*S^2.*Y.^3*(S_v))/exp(2*Z4)-(S^2.*Y.^3*(S_v))/(2*exp(Z4))...$
 $+(3*S*(S_v))/(exp(4*Z4)*Z4^3)-(4*S*(S_v))/(exp(3*Z4)*Z4^3)+(S*(S_v))/(exp(2*Z4)*Z4^3)+$
 $(S*(S_v))/(exp(2.*Y.*Z4)*Z4^3)+(3*exp(-2*Z4-2.*Y.*Z4)*S*(S_v))/Z4^3...$
 $-(4*exp(-Z4-2.*Y.*Z4)*S*(S_v))/Z4^3-(6*exp(-3*Z4-Y.*Z4)*S*(S_v))/Z4^3+(8*exp(-2*Z4-Y.*Z4)*S*(S_v))/Z4^3-$
 $(2*exp(-Z4-Y.*Z4)*S*(S_v))/Z4^3...$
 $+(3*S^2*(S_v))/(exp(4*Z4)*Z4^3)-(4*S^2*(S_v))/(exp(3*Z4)*Z4^3)+(4*S^2*(S_v))/(exp(2*Z4)*Z4^3)+$
 $(S^2*(S_v))/(exp(2*Z4)*Z4^3)+(S^2*(S_v))/(exp(2.*Y.*Z4)*Z4^3)+(3*exp(-2*Z4-2.*Y.*Z4)*S^2*(S_v))/Z4^3...$
 $-(4*exp(-Z4-2.*Y.*Z4)*S^2*(S_v))/Z4^3-(6*exp(-3*Z4-Y.*Z4)*S^2*(S_v))/Z4^3+(8*exp(-2*Z4-Y.*Z4)*S^2*(S_v))/Z4^3-$
 $(2*exp(-Z4-Y.*Z4)*S^2*(S_v))/Z4^3...$
 $+(11*S*(S_v))/(exp(3*Z4)*Z4^2)-(8*S*(S_v))/(exp(2*Z4)*Z4^2)+(2*S*(S_v))/(exp(Z4)*Z4^2)-$
 $(S*(S_v))/(exp(3.*Y.*Z4)*Z4^2)-(2*S*(S_v))/(exp(Y.*Z4)*Z4^2)...$
 $-(exp(-Z4-2.*Y.*Z4)*S*(S_v))/Z4^2-(9*exp(-2*Z4-Y.*Z4)*S*(S_v))/Z4^2+(8*exp(-Z4-Y.*Z4)*S*(S_v))/Z4^2+$
 $(8*S^2*(S_v))/(exp(3*Z4)*Z4^2);...$
 $-(4*S^2*(S_v))/(exp(2*Z4)*Z4^2)+(S^2*(S_v))/(exp(Z4)*Z4^2)-$
 $(S^2*(S_v))/(exp(3.*Y.*Z4)*Z4^2)-(S^2*(S_v))/(exp(Y.*Z4)*Z4^2)-(exp(-Z4-2.*Y.*Z4)*S^2*(S_v))/Z4^2...$
 $-(6*exp(-2*Z4-Y.*Z4)*S^2*(S_v))/Z4^2+(4*exp(-Z4-Y.*Z4)*S^2*(S_v))/Z4^2-$
 $(6*S.*Y*(S_v))/(exp(3*Z4)*Z4^2)+(8*S.*Y*(S_v))/(exp(2*Z4)*Z4^2)...$
 $-(2*S.*Y*(S_v))/(exp(Z4)*Z4^2)+(2*S.*Y*(S_v))/(exp(Y.*Z4)*Z4^2)+(6*exp(-2*Z4-Y.*Z4)*S.*Y*(S_v))/Z4^2-$
 $(8*exp(-Z4-Y.*Z4)*S.*Y*(S_v))/Z4^2...$
 $-(3*S^2.*Y*(S_v))/(exp(3*Z4)*Z4^2)+(4*S^2.*Y*(S_v))/(exp(2*Z4)*Z4^2)-$
 $(S^2.*Y*(S_v))/(exp(Z4)*Z4^2)+(S^2.*Y*(S_v))/(exp(Y.*Z4)*Z4^2)...$
 $+(3*exp(-2*Z4-Y.*Z4)*S^2.*Y*(S_v))/Z4^2-(4*exp(-Z4-Y.*Z4)*S^2.*Y*(S_v))/Z4^2+$
 $(S*(S_v))/Z4+(2*S*(S_v))/(exp(3*Z4)*Z4)+(9*S*(S_v))/(exp(2*Z4)*Z4)...$
 $-(4*S*(S_v))/(exp(Z4)*Z4)+(S*(S_v))/(exp(2.*Y.*Z4)*Z4)-(2*exp(-2*Z4-Y.*Z4)*S*(S_v))/Z4+$
 $(exp(-Z4-Y.*Z4)*S*(S_v))/Z4+(2*S^2*(S_v))/(exp(3*Z4)*Z4)...$
 $+(S^2*(S_v))/(exp(2*Z4)*Z4)-(2*exp(-2*Z4-Y.*Z4)*S^2*(S_v))/Z4-(exp(-Z4-Y.*Z4)*S^2*(S_v))/Z4-$
 $(2*S.*Y*(S_v))/Z4-(13*S.*Y*(S_v))/(exp(2*Z4)*Z4)...$

$$\begin{aligned}
& + (8*S.*Y.*(S_v))/(exp(Z4)*Z4) - (S.*Y.*(S_v))./(exp(2.*Y.*Z4)*Z4) - \\
& (2*S^2.*Y.*(S_v))/(exp(2*Z4)*Z4) + (2*exp(-Z4 - Y.*Z4)*S^2.*Y.*(S_v))/Z4 + (S.*Y.^2*(S_v))/Z4 ... \\
& + (3*S.*Y.^2*(S_v))/(exp(4*Z4)*Z4) - (4*S.*Y.^2*(S_v))/(exp(3*Z4)*Z4) + \\
& (4*S.*Y.^2*(S_v))/(exp(2*Z4)*Z4) - (4*S.*Y.^2*(S_v))/(exp(Z4)*Z4) ... \\
& - (3*exp(-3*Z4 - Y.*Z4)*S.*Y.^2*(S_v))/Z4 + (4*exp(-2*Z4 - Y.*Z4)*S.*Y.^2*(S_v))/Z4 - (exp(-Z4 - \\
& Y.*Z4)*S.*Y.^2*(S_v))/Z4 + (3*S^2.*Y.^2*(S_v))/(exp(4*Z4)*Z4) ... \\
& - (4*S^2.*Y.^2*(S_v))/(exp(3*Z4)*Z4) + (S^2.*Y.^2*(S_v))/(exp(2*Z4)*Z4) - (3*exp(-3*Z4 - \\
& Y.*Z4)*S^2.*Y.^2*(S_v))/Z4 + (4*exp(-2*Z4 - Y.*Z4)*S^2.*Y.^2*(S_v))/Z4 ... \\
& - (exp(-Z4 - Y.*Z4)*S^2.*Y.^2*(S_v))/Z4 - (3*S*Z4*(S_v))/(4*exp(4*Z4)) - \\
& (7*S*Z4*(S_v))/(4*exp(2*Z4)) - (3*S^2*Z4*(S_v))/(4*exp(4*Z4)) - (3*S^2*Z4*(S_v))/(4*exp(2*Z4)) ... \\
& + (2*S.*Y.*Z4*(S_v))/exp(2*Z4) + (S^2.*Y.*Z4*(S_v))/exp(2*Z4) + (S.*Y.^2*Z4*(S_v))/exp(3*Z4) + \\
& (3*S.*Y.^2*Z4*(S_v))/(2*exp(2*Z4)) + (S^2.*Y.^2*Z4*(S_v))/exp(3*Z4) ... \\
& + (S^2.*Y.^2*Z4*(S_v))/(2*exp(2*Z4)) - (2*S.*Y.^3*Z4*(S_v))/exp(2*Z4) - \\
& (S^2.*Y.^3*Z4*(S_v))/exp(2*Z4) + (3*S.*Y.^4*Z4*(S_v))/(4*exp(4*Z4)) - \\
& (S.*Y.^4*Z4*(S_v))/exp(3*Z4) ... \\
& + (S.*Y.^4*Z4*(S_v))/(4*exp(2*Z4)) + (3*S^2.*Y.^4*Z4*(S_v))/(4*exp(4*Z4)) - \\
& (S^2.*Y.^4*Z4*(S_v))/exp(3*Z4) + (S^2.*Y.^4*Z4*(S_v))/(4*exp(2*Z4)) + \\
& (S*Z4^2*(S_v))/(2*exp(3*Z4)) ... \\
& + (S^2*Z4^2*(S_v))/(2*exp(3*Z4)) - (S.*Y.^2*Z4^2*(S_v))/exp(3*Z4) - \\
& (S^2.*Y.^2*Z4^2*(S_v))/exp(3*Z4) + (S.*Y.^4*Z4^2*(S_v))/(2*exp(3*Z4)) ... \\
& + (S^2.*Y.^4*Z4^2*(S_v))/(2*exp(3*Z4)) + (9*S^2*(S_v)^2)/(16*exp(6*Z4)) - \\
& (23*S^2*(S_v)^2)/(8*exp(4*Z4)) + (2*S^2*(S_v)^2)/exp(3*Z4) + (S^2*(S_v)^2)/(16*exp(2*Z4)) ... \\
& - (exp(-2*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/2 - exp(-3*Z4 - Y.*Z4)*S^2*(S_v)^2 - \\
& (2*S^2.*Y.*(S_v)^2)/exp(3*Z4) - (S^2.*Y.*(S_v)^2)/exp(2*Z4) + (9*S^2.*Y.^2*(S_v)^2)/(8*exp(6*Z4)) \\
& ... \\
& - (3*S^2.*Y.^2*(S_v)^2)/(2*exp(5*Z4)) + (11*S^2.*Y.^2*(S_v)^2)/(2*exp(4*Z4)) - \\
& (7*S^2.*Y.^2*(S_v)^2)/(2*exp(3*Z4)) + (15*S^2.*Y.^2*(S_v)^2)/(8*exp(2*Z4)) ... \\
& + (exp(-2*Z4 - 2.*Y.*Z4)*S^2.*Y.^2*(S_v)^2)/2 + exp(-3*Z4 - Y.*Z4)*S^2.*Y.^2*(S_v)^2 - \\
& (3*S^2.*Y.^3*(S_v)^2)/exp(4*Z4) + (4*S^2.*Y.^3*(S_v)^2)/exp(3*Z4) ... \\
& - (S^2.*Y.^3*(S_v)^2)/exp(2*Z4) + (9*S^2.*Y.^4*(S_v)^2)/(16*exp(6*Z4)) - \\
& (3*S^2.*Y.^4*(S_v)^2)/(2*exp(5*Z4)) + (11*S^2.*Y.^4*(S_v)^2)/(8*exp(4*Z4)) ... \\
& - (S^2.*Y.^4*(S_v)^2)/(2*exp(3*Z4)) + (S^2.*Y.^4*(S_v)^2)/(16*exp(2*Z4)) + \\
& (9*S^2*(S_v)^2)/(4*exp(6*Z4)*Z4^4) - (6*S^2*(S_v)^2)/(exp(5*Z4)*Z4^4) ... \\
& + (11*S^2*(S_v)^2)/(2*exp(4*Z4)*Z4^4) - (2*S^2*(S_v)^2)/(exp(3*Z4)*Z4^4) + \\
& (S^2*(S_v)^2)/(4*exp(2*Z4)*Z4^4) + (S^2*(S_v)^2)/(4*exp(2.*Y.*Z4)*Z4^4) ... \\
& + (9*exp(-4*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(4*Z4^4) - (6*exp(-3*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/Z4^4 + \\
& (11*exp(-2*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(2*Z4^4) ... \\
& - (2*exp(-Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/Z4^4 - (9*exp(-5*Z4 - Y.*Z4)*S^2*(S_v)^2)/(2*Z4^4) + \\
& (12*exp(-4*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^4 - (11*exp(-3*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^4 ... \\
& + (4*exp(-2*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^4 - (exp(-Z4 - Y.*Z4)*S^2*(S_v)^2)/(2*Z4^4) + \\
& (12*S^2*(S_v)^2)/(exp(5*Z4)*Z4^3) - (22*S^2*(S_v)^2)/(exp(4*Z4)*Z4^3) ... \\
& + (27*S^2*(S_v)^2)/(2*exp(3*Z4)*Z4^3) - (4*S^2*(S_v)^2)/(exp(2*Z4)*Z4^3) + \\
& (S^2*(S_v)^2)/(2*exp(Z4)*Z4^3) - (S^2*(S_v)^2)/(2*exp(3.*Y.*Z4)*Z4^3) ... \\
& - (S^2*(S_v)^2)/(2*exp(Y.*Z4)*Z4^3) - (3*exp(-2*Z4 - 3.*Y.*Z4)*S^2*(S_v)^2)/(2*Z4^3) + (2*exp(- \\
& Z4 - 3.*Y.*Z4)*S^2*(S_v)^2)/Z4^3 - (3*exp(-3*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(2*Z4^3) ... \\
& + (2*exp(-2*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/Z4^3 - (exp(-Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(2*Z4^3) - \\
& (9*exp(-4*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^3 + (18*exp(-3*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^3 ... \\
& - (25*exp(-2*Z4 - Y.*Z4)*S^2*(S_v)^2)/(2*Z4^3) + (4*exp(-Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*exp(5*Z4)*Z4^3) + (12*S^2.*Y.*(S_v)^2)/(exp(4*Z4)*Z4^3) ... \\
& - (11*S^2.*Y.*(S_v)^2)/(exp(3*Z4)*Z4^3) + (4*S^2.*Y.*(S_v)^2)/(exp(2*Z4)*Z4^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*exp(Z4)*Z4^3) + (S^2.*Y.*(S_v)^2)/(2*exp(Y.*Z4)*Z4^3) ... \\
& + (9*exp(-4*Z4 - Y.*Z4)*S^2.*Y.*(S_v)^2)/(2*Z4^3) - (12*exp(-3*Z4 - \\
& Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4^3 + (11*exp(-2*Z4 - Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4^3 ... \\
& - (4*exp(-Z4 - Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4^3 + (S^2*(S_v)^2)/(4*Z4^2) + \\
& (9*S^2*(S_v)^2)/(4*exp(6*Z4)*Z4^2) - (3*S^2*(S_v)^2)/(exp(5*Z4)*Z4^2) + \\
& (19*S^2*(S_v)^2)/(exp(4*Z4)*Z4^2) ...
\end{aligned}$$

$$\begin{aligned}
& - (19*S^2*(S_v)^2)/(exp(3*Z4)*Z4^2) + (35*S^2*(S_v)^2)/(4*exp(2*Z4)*Z4^2) - \\
& (2*S^2*(S_v)^2)/(exp(Z4)*Z4^2) + (S^2*(S_v)^2)/(4*exp(4*Y.*Z4)*Z4^2) ... \\
& + (S^2*(S_v)^2)/(2*exp(2.*Y.*Z4)*Z4^2) + (exp(-Z4 - 3.*Y.*Z4)*S^2*(S_v)^2)/Z4^2 + (5*exp(-2*Z4 \\
& - 2.*Y.*Z4)*S^2*(S_v)^2)/Z4^2 - (2*exp(-Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/Z4^2 ... \\
& - (9*exp(-5*Z4 - Y.*Z4)*S^2*(S_v)^2)/(4*Z4^2) + (3*exp(-4*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^2 + \\
& (5*exp(-3*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^2 - (exp(-2*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4^2 ... \\
& + (exp(-Z4 - Y.*Z4)*S^2*(S_v)^2)/(4*Z4^2) - (S^2.*Y.*(S_v)^2)/(2*Z4^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(exp(4*Z4)*Z4^2) + (26*S^2.*Y.*(S_v)^2)/(exp(3*Z4)*Z4^2) ... \\
& - (29*S^2.*Y.*(S_v)^2)/(2*exp(2*Z4)*Z4^2) + (4*S^2.*Y.*(S_v)^2)/(exp(Z4)*Z4^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*exp(2.*Y.*Z4)*Z4^2) - (3*exp(-2*Z4 - 2.*Y.*Z4)*S^2.*Y.*(S_v)^2)/(2*Z4^2) ... \\
& + (2*exp(-Z4 - 2.*Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z4^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*exp(6*Z4)*Z4^2) - (6*S^2.*Y.^2*(S_v)^2)/(exp(5*Z4)*Z4^2) ... \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*exp(4*Z4)*Z4^2) - (8*S^2.*Y.^2*(S_v)^2)/(exp(3*Z4)*Z4^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*exp(2*Z4)*Z4^2) - (2*S^2.*Y.^2*(S_v)^2)/(exp(Z4)*Z4^2) ... \\
& - (9*exp(-5*Z4 - Y.*Z4)*S^2.*Y.^2*(S_v)^2)/(4*Z4^2) + (6*exp(-4*Z4 - \\
& Y.*Z4)*S^2.*Y.^2*(S_v)^2)/Z4^2 - (11*exp(-3*Z4 - Y.*Z4)*S^2.*Y.^2*(S_v)^2)/(2*Z4^2) ... \\
& + (2*exp(-2*Z4 - Y.*Z4)*S^2.*Y.^2*(S_v)^2)/Z4^2 - (exp(-Z4 - Y.*Z4)*S^2.*Y.^2*(S_v)^2)/(4*Z4^2) \\
& + (9*S^2*(S_v)^2)/(2*exp(5*Z4)*Z4) - (S^2*(S_v)^2)/(exp(4*Z4)*Z4) ... \\
& + (25*S^2*(S_v)^2)/(4*exp(3*Z4)*Z4) - (3*S^2*(S_v)^2)/(exp(2*Z4)*Z4) + \\
& (3*S^2*(S_v)^2)/(4*exp(Z4)*Z4) + (3*exp(-3*Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(4*Z4) ... \\
& + (3*exp(-Z4 - 2.*Y.*Z4)*S^2*(S_v)^2)/(4*Z4) + (3*exp(-4*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4 - (2*exp(- \\
& 3*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4 + (2*exp(-2*Z4 - Y.*Z4)*S^2*(S_v)^2)/Z4 ... \\
& - (9*S^2.*Y.*(S_v)^2)/(4*exp(5*Z4)*Z4) + (3*S^2.*Y.*(S_v)^2)/(exp(4*Z4)*Z4) - \\
& (11*S^2.*Y.*(S_v)^2)/(exp(3*Z4)*Z4) + (7*S^2.*Y.*(S_v)^2)/(exp(2*Z4)*Z4) ... \\
& - (7*S^2.*Y.*(S_v)^2)/(4*exp(Z4)*Z4) - (exp(-Z4 - 2.*Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4 - (2*exp(-2*Z4 - \\
& Y.*Z4)*S^2.*Y.*(S_v)^2)/Z4 + (15*S^2.*Y.^2*(S_v)^2)/(2*exp(5*Z4)*Z4) ... \\
& - (13*S^2.*Y.^2*(S_v)^2)/(exp(4*Z4)*Z4) + (41*S^2.*Y.^2*(S_v)^2)/(4*exp(3*Z4)*Z4) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(exp(2*Z4)*Z4) + (5*S^2.*Y.^2*(S_v)^2)/(4*exp(Z4)*Z4) ... \\
& + (3*exp(-3*Z4 - 2.*Y.*Z4)*S^2.*Y.^2*(S_v)^2)/(4*Z4) - (exp(-2*Z4 - \\
& 2.*Y.*Z4)*S^2.*Y.^2*(S_v)^2)/Z4 + (exp(-Z4 - 2.*Y.*Z4)*S^2.*Y.^2*(S_v)^2)/(4*Z4) ... \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*exp(5*Z4)*Z4) + (6*S^2.*Y.^3*(S_v)^2)/(exp(4*Z4)*Z4) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*exp(3*Z4)*Z4) + (2*S^2.*Y.^3*(S_v)^2)/(exp(2*Z4)*Z4) ... \\
& - (S^2.*Y.^3*(S_v)^2)/(4*exp(Z4)*Z4) - (3*S^2*Z4*(S_v)^2)/(4*exp(5*Z4)) - \\
& (3*S^2*Z4*(S_v)^2)/(4*exp(3*Z4)) + (S^2.*Y.*Z4*(S_v)^2)/exp(3*Z4) + \\
& (S^2.*Y.^2*Z4*(S_v)^2)/exp(4*Z4) ... \\
& + (S^2.*Y.^2*Z4*(S_v)^2)/(2*exp(3*Z4)) - (S^2.*Y.^3*Z4*(S_v)^2)/exp(3*Z4) + \\
& (3*S^2.*Y.^4*Z4*(S_v)^2)/(4*exp(5*Z4)) - (S^2.*Y.^4*Z4*(S_v)^2)/exp(4*Z4) ... \\
& + (S^2.*Y.^4*Z4*(S_v)^2)/(4*exp(3*Z4)) + (S^2*Z4^2*(S_v)^2)/(4*exp(4*Z4)) - \\
& (S^2.*Y.^2*Z4^2*(S_v)^2)/(2*exp(4*Z4)) + (S^2.*Y.^4*Z4^2*(S_v)^2)/(4*exp(4*Z4));
\end{aligned}$$

$$\begin{aligned}
Ns4 &= Nf4 + Nc + Ny4; \\
Phi4 &= Nf4./[Nc + Ny4]; \\
Be4 &= 1./[1 + Phi4]; \\
Gf4 &= Nf4./Ns4; \\
Gh4 &= [Nc + Ny4]./Ns4; \\
Nh4 &= Nc + Ny4;
\end{aligned}$$

$$\begin{aligned}
Z5 &= 15; \\
Nf5 &= Br*[(Z5^2)*exp(-2.*Y.*Z5) + (Z5^2)*exp(-2*Z5) - 2*Z5^2.*exp(-Z5 - Y.*Z5)]; \\
Ny5 &= 1 - exp(-2*Z5) + exp(-Z5 - Y.*Z5) - (2*S)/exp(2*Z5) + 2*exp(-Z5 - Y.*Z5)*S - S^2/exp(2*Z5) + \\
& exp(-Z5 - Y.*Z5)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z5) - exp(-Z5 - Y.*Z5).*Y.^2 ... \\
& + (2*S.*Y.^2)/exp(2*Z5) - 2*exp(-Z5 - Y.*Z5)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z5) - exp(-Z5 - \\
& Y.*Z5)*S^2.*Y.^2 + 1/(exp(2*Z5)*Z5^2) + 1./(exp(2.*Y.*Z5)*Z5^2) ... \\
& - (2*exp(-Z5 - Y.*Z5))/Z5^2 + (2*S)/(exp(2*Z5)*Z5^2) + (2*S)./(exp(2.*Y.*Z5)*Z5^2) - (4*exp(-Z5 - \\
& Y.*Z5)*S)/Z5^2 + S^2/(exp(2*Z5)*Z5^2) + S^2./(exp(2.*Y.*Z5)*Z5^2) ...
\end{aligned}$$

$$\begin{aligned}
& - (2*\exp(-Z5 - Y.*Z5)*S^2)/Z5^2 + 2/(\exp(Z5)*Z5) - 2./(\exp(Y.*Z5)*Z5) + (2*S)/(\exp(Z5)*Z5) - \\
& (2*S)/(\exp(Y.*Z5)*Z5) - (2.*Y)/(\exp(Z5)*Z5) + (2.*Y)/(\exp(Y.*Z5)*Z5) \dots \\
& - (2*S.*Y)/(\exp(Z5)*Z5) + (2*S.*Y)/(\exp(Y.*Z5)*Z5) - Z5/\exp(Z5) - (S*Z5)/\exp(Z5) + \\
& (Y.*Z5)/\exp(Z5) + (S.*Y.*Z5)/\exp(Z5) + (Y.^2*Z5)/\exp(Z5) + (S.*Y.^2*Z5)/\exp(Z5) - (Y.^3*Z5)/\exp(Z5) \\
& \dots \\
& - (S.*Y.^3*Z5)/\exp(Z5) + Z5^2/(4*\exp(2*Z5)) + (S*Z5^2)/(2*\exp(2*Z5)) + (S^2*Z5^2)/(4*\exp(2*Z5)) \\
& - (Y.^2*Z5^2)/(2*\exp(2*Z5)) - (S.*Y.^2*Z5^2)/\exp(2*Z5) \dots \\
& - (S^2.*Y.^2*Z5^2)/(2*\exp(2*Z5)) + (Y.^4*Z5^2)/(4*\exp(2*Z5)) + (S.*Y.^4*Z5^2)/(2*\exp(2*Z5)) + \\
& (S^2.*Y.^4*Z5^2)/(4*\exp(2*Z5)) - (7*S*(S_v))/(2*\exp(3*Z5)) \dots \\
& + (2*S*(S_v))/\exp(2*Z5) + (S*(S_v))/\exp(Z5) - (\exp(-Z5 - 2.*Y.*Z5)*S*(S_v))/2 - \\
& (5*S^2*(S_v))/\exp(3*Z5) + (2*S^2*(S_v))/\exp(2*Z5) - (S^2*(S_v))/(2*\exp(Z5)) \dots \\
& - (\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v))/2 - (2*S.*Y.*(S_v))/\exp(2*Z5) - (3*S.*Y.*(S_v))/\exp(Z5) + \\
& (3*S^2.*Y.*(S_v))/(2*\exp(3*Z5)) - (2*S^2.*Y.*(S_v))/\exp(2*Z5) \dots \\
& + (S^2.*Y.*(S_v))/(2*\exp(Z5)) + (13*S.*Y.^2*(S_v))/(2*\exp(3*Z5)) - (4*S.*Y.^2*(S_v))/\exp(2*Z5) + \\
& (3*S.*Y.^2*(S_v))/\exp(Z5) + (\exp(-Z5 - 2.*Y.*Z5)*S.*Y.^2*(S_v))/2 \dots \\
& + (5*S^2.*Y.^2*(S_v))/\exp(3*Z5) - (2*S^2.*Y.^2*(S_v))/\exp(2*Z5) + (S^2.*Y.^2*(S_v))/(2*\exp(Z5)) \\
& + (\exp(-Z5 - 2.*Y.*Z5)*S^2.*Y.^2*(S_v))/2 - (3*S.*Y.^3*(S_v))/\exp(3*Z5) \dots \\
& + (4*S.*Y.^3*(S_v))/\exp(2*Z5) - (S.*Y.^3*(S_v))/\exp(Z5) - (3*S^2.*Y.^3*(S_v))/(2*\exp(3*Z5)) + \\
& (2*S^2.*Y.^3*(S_v))/\exp(2*Z5) - (S^2.*Y.^3*(S_v))/(2*\exp(Z5)) \dots \\
& + (3*S*(S_v))/(\exp(4*Z5)*Z5^3) - (4*S*(S_v))/(\exp(3*Z5)*Z5^3) + (S*(S_v))/(\exp(2*Z5)*Z5^3) + \\
& (S*(S_v))/(\exp(2.*Y.*Z5)*Z5^3) + (3*\exp(-2*Z5 - 2.*Y.*Z5)*S*(S_v))/Z5^3 \dots \\
& - (4*\exp(-Z5 - 2.*Y.*Z5)*S*(S_v))/Z5^3 - (6*\exp(-3*Z5 - Y.*Z5)*S*(S_v))/Z5^3 + (8*\exp(-2*Z5 - \\
& Y.*Z5)*S*(S_v))/Z5^3 - (2*\exp(-Z5 - Y.*Z5)*S*(S_v))/Z5^3 \dots \\
& + (3*S^2*(S_v))/(\exp(4*Z5)*Z5^3) - (4*S^2*(S_v))/(\exp(3*Z5)*Z5^3) + \\
& (S^2*(S_v))/(\exp(2*Z5)*Z5^3) + (S^2*(S_v))/(\exp(2.*Y.*Z5)*Z5^3) + (3*\exp(-2*Z5 - \\
& 2.*Y.*Z5)*S^2*(S_v))/Z5^3 \dots \\
& - (4*\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v))/Z5^3 - (6*\exp(-3*Z5 - Y.*Z5)*S^2*(S_v))/Z5^3 + (8*\exp(-2*Z5 \\
& - Y.*Z5)*S^2*(S_v))/Z5^3 - (2*\exp(-Z5 - Y.*Z5)*S^2*(S_v))/Z5^3 \dots \\
& + (11*S*(S_v))/(\exp(3*Z5)*Z5^2) - (8*S*(S_v))/(\exp(2*Z5)*Z5^2) + (2*S*(S_v))/(\exp(Z5)*Z5^2) - \\
& (S*(S_v))/(\exp(3.*Y.*Z5)*Z5^2) - (2*S*(S_v))/(\exp(Y.*Z5)*Z5^2) \dots \\
& - (\exp(-Z5 - 2.*Y.*Z5)*S*(S_v))/Z5^2 - (9*\exp(-2*Z5 - Y.*Z5)*S*(S_v))/Z5^2 + (8*\exp(-Z5 - \\
& Y.*Z5)*S*(S_v))/Z5^2 + (8*S^2*(S_v))/(\exp(3*Z5)*Z5^2); \dots \\
& - (4*S^2*(S_v))/(\exp(2*Z5)*Z5^2) + (S^2*(S_v))/(\exp(Z5)*Z5^2) - \\
& (S^2*(S_v))/(\exp(3.*Y.*Z5)*Z5^2) - (S^2*(S_v))/(\exp(Y.*Z5)*Z5^2) - (\exp(-Z5 - \\
& 2.*Y.*Z5)*S^2*(S_v))/Z5^2 \dots \\
& - (6*\exp(-2*Z5 - Y.*Z5)*S^2*(S_v))/Z5^2 + (4*\exp(-Z5 - Y.*Z5)*S^2*(S_v))/Z5^2 - \\
& (6*S.*Y.*(S_v))/(\exp(3*Z5)*Z5^2) + (8*S.*Y.*(S_v))/(\exp(2*Z5)*Z5^2) \dots \\
& - (2*S.*Y.*(S_v))/(\exp(Z5)*Z5^2) + (2*S.*Y.*(S_v))/(\exp(Y.*Z5)*Z5^2) + (6*\exp(-2*Z5 - \\
& Y.*Z5)*S.*Y.*(S_v))/Z5^2 - (8*\exp(-Z5 - Y.*Z5)*S.*Y.*(S_v))/Z5^2 \dots \\
& - (3*S^2.*Y.*(S_v))/(\exp(3*Z5)*Z5^2) + (4*S^2.*Y.*(S_v))/(\exp(2*Z5)*Z5^2) - \\
& (S^2.*Y.*(S_v))/(\exp(Z5)*Z5^2) + (S^2.*Y.*(S_v))/(\exp(Y.*Z5)*Z5^2) \dots \\
& + (3*\exp(-2*Z5 - Y.*Z5)*S^2.*Y.*(S_v))/Z5^2 - (4*\exp(-Z5 - Y.*Z5)*S^2.*Y.*(S_v))/Z5^2 + \\
& (S*(S_v))/Z5 + (2*S*(S_v))/(\exp(3*Z5)*Z5) + (9*S*(S_v))/(\exp(2*Z5)*Z5) \dots \\
& - (4*S*(S_v))/(\exp(Z5)*Z5) + (S*(S_v))/(\exp(2.*Y.*Z5)*Z5) - (2*\exp(-2*Z5 - Y.*Z5)*S*(S_v))/Z5 + \\
& (\exp(-Z5 - Y.*Z5)*S*(S_v))/Z5 + (2*S^2*(S_v))/(\exp(3*Z5)*Z5) \dots \\
& + (S^2*(S_v))/(\exp(2*Z5)*Z5) - (2*\exp(-2*Z5 - Y.*Z5)*S^2*(S_v))/Z5 - (\exp(-Z5 - \\
& Y.*Z5)*S^2*(S_v))/Z5 - (2*S.*Y.*(S_v))/Z5 - (13*S.*Y.*(S_v))/(\exp(2*Z5)*Z5) \dots \\
& + (8*S.*Y.*(S_v))/(\exp(Z5)*Z5) - (S.*Y.*(S_v))/(\exp(2.*Y.*Z5)*Z5) - \\
& (2*S^2.*Y.*(S_v))/(\exp(2*Z5)*Z5) + (2*\exp(-Z5 - Y.*Z5)*S^2.*Y.*(S_v))/Z5 + (S.*Y.^2*(S_v))/Z5 \dots \\
& + (3*S.*Y.^2*(S_v))/(\exp(4*Z5)*Z5) - (4*S.*Y.^2*(S_v))/(\exp(3*Z5)*Z5) + \\
& (4*S.*Y.^2*(S_v))/(\exp(2*Z5)*Z5) - (4*S.*Y.^2*(S_v))/(\exp(Z5)*Z5) \dots \\
& - (3*\exp(-3*Z5 - Y.*Z5)*S.*Y.^2*(S_v))/Z5 + (4*\exp(-2*Z5 - Y.*Z5)*S.*Y.^2*(S_v))/Z5 - (\exp(-Z5 - \\
& Y.*Z5)*S.*Y.^2*(S_v))/Z5 + (3*S^2.*Y.^2*(S_v))/(\exp(4*Z5)*Z5) \dots \\
& - (4*S^2.*Y.^2*(S_v))/(\exp(3*Z5)*Z5) + (S^2.*Y.^2*(S_v))/(\exp(2*Z5)*Z5) - (3*\exp(-3*Z5 - \\
& Y.*Z5)*S^2.*Y.^2*(S_v))/Z5 + (4*\exp(-2*Z5 - Y.*Z5)*S^2.*Y.^2*(S_v))/Z5 \dots
\end{aligned}$$

$$\begin{aligned}
& - (\exp(-Z5 - Y.*Z5)*S^2.*Y.^2*(S_v))/Z5 - (3*S^2*Z5*(S_v))/(4*\exp(4*Z5)) - \\
& (7*S^2*Z5*(S_v))/(4*\exp(2*Z5)) - (3*S^2*Z5*(S_v))/(4*\exp(4*Z5)) - (3*S^2*Z5*(S_v))/(4*\exp(2*Z5)) \dots \\
& + (2*S.*Y.*Z5*(S_v))/\exp(2*Z5) + (S^2.*Y.*Z5*(S_v))/\exp(2*Z5) + (S.*Y.^2*Z5*(S_v))/\exp(3*Z5) + \\
& (3*S.*Y.^2*Z5*(S_v))/(2*\exp(2*Z5)) + (S^2.*Y.^2*Z5*(S_v))/\exp(3*Z5) \dots \\
& + (S^2.*Y.^2*Z5*(S_v))/(2*\exp(2*Z5)) - (2*S.*Y.^3*Z5*(S_v))/\exp(2*Z5) - \\
& (S^2.*Y.^3*Z5*(S_v))/\exp(2*Z5) + (3*S.*Y.^4*Z5*(S_v))/(4*\exp(4*Z5)) - \\
& (S.*Y.^4*Z5*(S_v))/\exp(3*Z5) \dots \\
& + (S.*Y.^4*Z5*(S_v))/(4*\exp(2*Z5)) + (3*S^2.*Y.^4*Z5*(S_v))/(4*\exp(4*Z5)) - \\
& (S^2.*Y.^4*Z5*(S_v))/\exp(3*Z5) + (S^2.*Y.^4*Z5*(S_v))/(4*\exp(2*Z5)) + \\
& (S*Z5^2*(S_v))/(2*\exp(3*Z5)) \dots \\
& + (S^2*Z5^2*(S_v))/(2*\exp(3*Z5)) - (S.*Y.^2*Z5^2*(S_v))/\exp(3*Z5) - \\
& (S^2.*Y.^2*Z5^2*(S_v))/\exp(3*Z5) + (S.*Y.^4*Z5^2*(S_v))/(2*\exp(3*Z5)) \dots \\
& + (S^2.*Y.^4*Z5^2*(S_v))/(2*\exp(3*Z5)) + (9*S^2*(S_v)^2)/(16*\exp(6*Z5)) - \\
& (23*S^2*(S_v)^2)/(8*\exp(4*Z5)) + (2*S^2*(S_v)^2)/\exp(3*Z5) + (S^2*(S_v)^2)/(16*\exp(2*Z5)) \dots \\
& - (\exp(-2*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/2 - \exp(-3*Z5 - Y.*Z5)*S^2*(S_v)^2 - \\
& (2*S^2.*Y.*(S_v)^2)/\exp(3*Z5) - (S^2.*Y.*(S_v)^2)/\exp(2*Z5) + (9*S^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z5)) \\
& \dots \\
& - (3*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z5)) + (11*S^2.*Y.^2*(S_v)^2)/(2*\exp(4*Z5)) - \\
& (7*S^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z5)) + (15*S^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z5)) \dots \\
& + (\exp(-2*Z5 - 2.*Y.*Z5)*S^2.*Y.^2*(S_v)^2)/2 + \exp(-3*Z5 - Y.*Z5)*S^2.*Y.^2*(S_v)^2 - \\
& (3*S^2.*Y.^3*(S_v)^2)/\exp(4*Z5) + (4*S^2.*Y.^3*(S_v)^2)/\exp(3*Z5) \dots \\
& - (S^2.*Y.^3*(S_v)^2)/\exp(2*Z5) + (9*S^2.*Y.^4*(S_v)^2)/(16*\exp(6*Z5)) - \\
& (3*S^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z5)) + (11*S^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z5)) \dots \\
& - (S^2.*Y.^4*(S_v)^2)/(2*\exp(3*Z5)) + (S^2.*Y.^4*(S_v)^2)/(16*\exp(2*Z5)) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z5)*Z5^4) - (6*S^2*(S_v)^2)/(\exp(5*Z5)*Z5^4) \dots \\
& + (11*S^2*(S_v)^2)/(2*\exp(4*Z5)*Z5^4) - (2*S^2*(S_v)^2)/(\exp(3*Z5)*Z5^4) + \\
& (S^2*(S_v)^2)/(4*\exp(2*Z5)*Z5^4) + (S^2*(S_v)^2)/(4*\exp(2.*Y.*Z5)*Z5^4) \dots \\
& + (9*\exp(-4*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(4*Z5^4) - (6*\exp(-3*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/Z5^4 + \\
& (11*\exp(-2*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(2*Z5^4) \dots \\
& - (2*\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/Z5^4 - (9*\exp(-5*Z5 - Y.*Z5)*S^2*(S_v)^2)/(2*Z5^4) + \\
& (12*\exp(-4*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^4 - (11*\exp(-3*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^4 \dots \\
& + (4*\exp(-2*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^4 - (\exp(-Z5 - Y.*Z5)*S^2*(S_v)^2)/(2*Z5^4) + \\
& (12*S^2*(S_v)^2)/(\exp(5*Z5)*Z5^3) - (22*S^2*(S_v)^2)/(\exp(4*Z5)*Z5^3) \dots \\
& + (27*S^2*(S_v)^2)/(2*\exp(3*Z5)*Z5^3) - (4*S^2*(S_v)^2)/(\exp(2*Z5)*Z5^3) + \\
& (S^2*(S_v)^2)/(2*\exp(Z5)*Z5^3) - (S^2*(S_v)^2)/(2*\exp(3.*Y.*Z5)*Z5^3) \dots \\
& - (S^2*(S_v)^2)/(2*\exp(Y.*Z5)*Z5^3) - (3*\exp(-2*Z5 - 3.*Y.*Z5)*S^2*(S_v)^2)/(2*Z5^3) + (2*\exp(- \\
& Z5 - 3.*Y.*Z5)*S^2*(S_v)^2)/Z5^3 - (3*\exp(-3*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(2*Z5^3) \dots \\
& + (2*\exp(-2*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/Z5^3 - (\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(2*Z5^3) - \\
& (9*\exp(-4*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^3 + (18*\exp(-3*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^3 \dots \\
& - (25*\exp(-2*Z5 - Y.*Z5)*S^2*(S_v)^2)/(2*Z5^3) + (4*\exp(-Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*\exp(5*Z5)*Z5^3) + (12*S^2.*Y.*(S_v)^2)/(\exp(4*Z5)*Z5^3) \dots \\
& - (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z5)*Z5^3) + (4*S^2.*Y.*(S_v)^2)/(\exp(2*Z5)*Z5^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(Z5)*Z5^3) + (S^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z5)*Z5^3) \dots \\
& + (9*\exp(-4*Z5 - Y.*Z5)*S^2.*Y.*(S_v)^2)/(2*Z5^3) - (12*\exp(-3*Z5 - \\
& Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5^3 + (11*\exp(-2*Z5 - Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5^3 \dots \\
& - (4*\exp(-Z5 - Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5^3 + (S^2*(S_v)^2)/(4*Z5^2) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z5)*Z5^2) - (3*S^2*(S_v)^2)/(\exp(5*Z5)*Z5^2) + \\
& (19*S^2*(S_v)^2)/(\exp(4*Z5)*Z5^2) \dots \\
& - (19*S^2*(S_v)^2)/(\exp(3*Z5)*Z5^2) + (35*S^2*(S_v)^2)/(4*\exp(2*Z5)*Z5^2) - \\
& (2*S^2*(S_v)^2)/(\exp(Z5)*Z5^2) + (S^2*(S_v)^2)/(4*\exp(4.*Y.*Z5)*Z5^2) \dots \\
& + (S^2*(S_v)^2)/(2*\exp(2.*Y.*Z5)*Z5^2) + (\exp(-Z5 - 3.*Y.*Z5)*S^2*(S_v)^2)/Z5^2 + (5*\exp(-2*Z5 \\
& - 2.*Y.*Z5)*S^2*(S_v)^2)/Z5^2 - (2*\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/Z5^2 \dots \\
& - (9*\exp(-5*Z5 - Y.*Z5)*S^2*(S_v)^2)/(4*Z5^2) + (3*\exp(-4*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^2 + \\
& (5*\exp(-3*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^2 - (\exp(-2*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5^2 \dots \\
& + (\exp(-Z5 - Y.*Z5)*S^2*(S_v)^2)/(4*Z5^2) - (S^2.*Y.*(S_v)^2)/(2*Z5^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(\exp(4*Z5)*Z5^2) + (26*S^2.*Y.*(S_v)^2)/(\exp(3*Z5)*Z5^2) \dots
\end{aligned}$$

$$\begin{aligned}
& - (29*S^2.*Y.*(S_v)^2)/(2*\exp(2*Z5)*Z5^2) + (4*S^2.*Y.*(S_v)^2)/(\exp(Z5)*Z5^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z5)*Z5^2) - (3*\exp(-2*Z5 - 2.*Y.*Z5)*S^2.*Y.*(S_v)^2)/(2*Z5^2) \dots \\
& + (2*\exp(-Z5 - 2.*Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z5^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z5)*Z5^2) - (6*S^2.*Y.^2*(S_v)^2)/(\exp(5*Z5)*Z5^2) \dots \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z5)*Z5^2) - (8*S^2.*Y.^2*(S_v)^2)/(\exp(3*Z5)*Z5^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z5)*Z5^2) - (2*S^2.*Y.^2*(S_v)^2)/(\exp(Z5)*Z5^2) \dots \\
& - (9*\exp(-5*Z5 - Y.*Z5)*S^2.*Y.^2*(S_v)^2)/(4*Z5^2) + (6*\exp(-4*Z5 - \\
& Y.*Z5)*S^2.*Y.^2*(S_v)^2)/Z5^2 - (11*\exp(-3*Z5 - Y.*Z5)*S^2.*Y.^2*(S_v)^2)/(2*Z5^2) \dots \\
& + (2*\exp(-2*Z5 - Y.*Z5)*S^2.*Y.^2*(S_v)^2)/Z5^2 - (\exp(-Z5 - Y.*Z5)*S^2.*Y.^2*(S_v)^2)/(4*Z5^2) \\
& + (9*S^2*(S_v)^2)/(2*\exp(5*Z5)*Z5) - (S^2*(S_v)^2)/(\exp(4*Z5)*Z5) \dots \\
& + (25*S^2*(S_v)^2)/(4*\exp(3*Z5)*Z5) - (3*S^2*(S_v)^2)/(\exp(2*Z5)*Z5) + \\
& (3*S^2*(S_v)^2)/(4*\exp(Z5)*Z5) + (3*\exp(-3*Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(4*Z5) \dots \\
& + (3*\exp(-Z5 - 2.*Y.*Z5)*S^2*(S_v)^2)/(4*Z5) + (3*\exp(-4*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5 - (2*\exp(- \\
& 3*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5 + (2*\exp(-2*Z5 - Y.*Z5)*S^2*(S_v)^2)/Z5 \dots \\
& - (9*S^2.*Y.*(S_v)^2)/(4*\exp(5*Z5)*Z5) + (3*S^2.*Y.*(S_v)^2)/(\exp(4*Z5)*Z5) - \\
& (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z5)*Z5) + (7*S^2.*Y.*(S_v)^2)/(\exp(2*Z5)*Z5) \dots \\
& - (7*S^2.*Y.*(S_v)^2)/(4*\exp(Z5)*Z5) - (\exp(-Z5 - 2.*Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5 - (2*\exp(-2*Z5 - \\
& Y.*Z5)*S^2.*Y.*(S_v)^2)/Z5 + (15*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z5)*Z5) \dots \\
& - (13*S^2.*Y.^2*(S_v)^2)/(\exp(4*Z5)*Z5) + (41*S^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z5)*Z5) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(\exp(2*Z5)*Z5) + (5*S^2.*Y.^2*(S_v)^2)/(4*\exp(Z5)*Z5) \dots \\
& + (3*\exp(-3*Z5 - 2.*Y.*Z5)*S^2.*Y.^2*(S_v)^2)/(4*Z5) - (\exp(-2*Z5 - \\
& 2.*Y.*Z5)*S^2.*Y.^2*(S_v)^2)/Z5 + (\exp(-Z5 - 2.*Y.*Z5)*S^2.*Y.^2*(S_v)^2)/(4*Z5) \dots \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z5)*Z5) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z5)*Z5) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z5)*Z5) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z5)*Z5) \dots \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z5)*Z5) - (3*S^2*Z5*(S_v)^2)/(4*\exp(5*Z5)) - \\
& (3*S^2*Z5*(S_v)^2)/(4*\exp(3*Z5)) + (S^2.*Y.*Z5*(S_v)^2)/\exp(3*Z5) + \\
& (S^2.*Y.^2*Z5*(S_v)^2)/\exp(4*Z5) \dots \\
& + (S^2.*Y.^2*Z5*(S_v)^2)/(2*\exp(3*Z5)) - (S^2.*Y.^3*Z5*(S_v)^2)/\exp(3*Z5) + \\
& (3*S^2.*Y.^4*Z5*(S_v)^2)/(4*\exp(5*Z5)) - (S^2.*Y.^4*Z5*(S_v)^2)/\exp(4*Z5) \dots \\
& + (S^2.*Y.^4*Z5*(S_v)^2)/(4*\exp(3*Z5)) + (S^2*Z5^2*(S_v)^2)/(4*\exp(4*Z5)) - \\
& (S^2.*Y.^2*Z5^2*(S_v)^2)/(2*\exp(4*Z5)) + (S^2.*Y.^4*Z5^2*(S_v)^2)/(4*\exp(4*Z5));
\end{aligned}$$

Ns5=Nf5+Nc+Ny5;
Phi5=Nf5./[Nc+Ny5];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gh5=[Nc+Ny5]./Ns5;
Nh5=Nc+Ny5;

plot(Y,Ns1,'b',Y,Ns2,'g',Y,Ns3,'r',Y,Ns4,'k',Y,Ns5,'m')

% plot(Y,Be1,'b',Y,Be2,'g',Y,Be3,'r',Y,Be4,'k',Y,Be5,'m')

% plot(Y,Phi1,'b',Y,Phi2,'g',Y,Phi3,'r',Y,Phi4,'k',Y,Phi5,'m')

% plot(Y,Gf1,'b',Y,Gf2,'g',Y,Gf3,'r',Y,Gf4,'k',Y,Gf5,'m')

% plot(Y,Gh1,'b',Y,Gh2,'g',Y,Gh3,'r',Y,Gh4,'k',Y,Gh5,'m')

% plot(Y,Nf1,'b',Y,Nf2,'g',Y,Nf3,'r',Y,Nf4,'k',Y,Nf5,'m')

% plot(Y,Nh1,'b',Y,Nh2,'g',Y,Nh3,'r',Y,Nh4,'k',Y,Nh5,'m')

% plot(Nh1,Nf1,'b',Nh2,Nf2,'g',Nh3,Nf3,'r',Nh4,Nf4,'k',Nh5,Nf5,'m')
PLOTTOOLS ON

1.3. Distribution of $N_s, Be, \Phi, G_F, G_H, N_C$ and N_H versus Y for a range of

Pe and set of S, S_v, Z & Br

$S=1; S_v=1; Z=1; Br=1;$

$\% S=5; S_v=0.75; Z=7.5; Br=0.4;$

$\% \% \% \% S=2; S_v=5; Z=6; Br=0.5;$

$\% \% \% \% S=2; S_v=1.5; Z=5; Br=0.4;$

$\% \% \% \% S=25; S_v=15; Z=10; Br=0.6;$

$\% \% \% \% S=10; S_v=25; Z=20; Br=0.5;$

$q=1.86;$

$s=1;$

$Dh=250*10^{-6};$

$Y=0:0.005:1;$

$Nf=Br*((Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2.*Z)-2.*Z^2.*exp(-Z-Y.*Z));$

$Ny=1 - exp(-2.*Z) + exp(-Z - Y.*Z) - (2.*S)/exp(2.*Z) + 2.*exp(-Z - Y.*Z)*S - S^2/exp(2.*Z) + exp(-Z - Y.*Z)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2.*Z) - exp(-Z - Y.*Z).*Y.^2 ...$
 $+ (2.*S.*Y.^2)/exp(2.*Z) - 2.*exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/exp(2.*Z) - exp(-Z - Y.*Z)*S^2.*Y.^2 + 1/(exp(2.*Z)*Z^2) + 1./(exp(2.*Y.*Z)*Z^2) ...$
 $- (2.*exp(-Z - Y.*Z))/Z^2 + (2.*S)/(exp(2.*Z)*Z^2) + (2.*S)./(exp(2.*Y.*Z)*Z^2) - (4.*exp(-Z - Y.*Z)*S)/Z^2 + S^2/(exp(2.*Z)*Z^2) + S^2./(exp(2.*Y.*Z)*Z^2) ...$
 $- (2.*exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(exp(Z)*Z) - 2./(exp(Y.*Z)*Z) + (2.*S)/(exp(Z)*Z) - (2.*S)./(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...$
 $- (2.*S.*Y)/(exp(Z)*Z) + (2.*S.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S.*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S.*Y.*Z)/exp(Z) + (Y.^2.*Z)/exp(Z) + (S.*Y.^2.*Z)/exp(Z) - (Y.^3.*Z)/exp(Z) ...$
 $- (S.*Y.^3.*Z)/exp(Z) + Z^2/(4.*exp(2.*Z)) + (S.*Z^2)/(2.*exp(2.*Z)) + (S^2.*Z^2)/(4.*exp(2.*Z)) - (Y.^2.*Z^2)/(2.*exp(2.*Z)) - (S.*Y.^2.*Z^2)/exp(2.*Z) ...$
 $- (S^2.*Y.^2.*Z^2)/(2.*exp(2.*Z)) + (Y.^4.*Z^2)/(4.*exp(2.*Z)) + (S.*Y.^4.*Z^2)/(2.*exp(2.*Z)) + (S^2.*Y.^4.*Z^2)/(4.*exp(2.*Z)) - (7.*S*(S_v))/(2.*exp(3.*Z)) ...$
 $+ (2.*S*(S_v))/exp(2.*Z) + (S*(S_v))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S*(S_v))/2 - (5.*S^2*(S_v))/exp(3.*Z) + (2.*S^2*(S_v))/exp(2.*Z) - (S^2*(S_v))/(2.*exp(Z)) ...$
 $- (exp(-Z - 2.*Y.*Z)*S^2*(S_v))/2 - (2.*S.*Y*(S_v))/exp(2.*Z) - (3.*S.*Y*(S_v))/exp(Z) + (3.*S^2.*Y*(S_v))/(2.*exp(3.*Z)) - (2.*S^2.*Y*(S_v))/exp(2.*Z) ...$
 $+ (S^2.*Y*(S_v))/(2.*exp(Z)) + (13.*S.*Y.^2*(S_v))/(2.*exp(3.*Z)) - (4.*S.*Y.^2*(S_v))/exp(2.*Z) + (3.*S.*Y.^2*(S_v))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S.*Y.^2*(S_v))/2 ...$
 $+ (5.*S^2.*Y.^2*(S_v))/exp(3.*Z) - (2.*S^2.*Y.^2*(S_v))/exp(2.*Z) + (S^2.*Y.^2*(S_v))/(2.*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v))/2 - (3.*S.*Y.^3*(S_v))/exp(3.*Z) ...$
 $+ (4.*S.*Y.^3*(S_v))/exp(2.*Z) - (S.*Y.^3*(S_v))/exp(Z) - (3.*S^2.*Y.^3*(S_v))/(2.*exp(3.*Z)) + (2.*S^2.*Y.^3*(S_v))/exp(2.*Z) - (S^2.*Y.^3*(S_v))/(2.*exp(Z)) ...$
 $+ (3.*S*(S_v))/(exp(4.*Z)*Z^3) - (4.*S*(S_v))/(exp(3.*Z)*Z^3) + (S*(S_v))/(exp(2.*Z)*Z^3) + (S*(S_v))./(exp(2.*Y.*Z)*Z^3) + (3.*exp(-2.*Z - 2.*Y.*Z)*S*(S_v))/Z^3 ...$
 $- (4.*exp(-Z - 2.*Y.*Z)*S*(S_v))/Z^3 - (6.*exp(-3.*Z - Y.*Z)*S*(S_v))/Z^3 + (8.*exp(-2.*Z - Y.*Z)*S*(S_v))/Z^3 - (2.*exp(-Z - Y.*Z)*S*(S_v))/Z^3 ...$
 $+ (3.*S^2*(S_v))/(exp(4.*Z)*Z^3) - (4.*S^2*(S_v))/(exp(3.*Z)*Z^3) + (S^2*(S_v))/(exp(2.*Z)*Z^3) + (S^2*(S_v))./(exp(2.*Y.*Z)*Z^3) + (3.*exp(-2.*Z - 2.*Y.*Z)*S^2*(S_v))/Z^3 ...$

$$\begin{aligned}
& - (4*\exp(-Z - 2.*Y.*Z)*S^2*(S_v))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S^2*(S_v))/Z^3 + (8*\exp(-2*Z - Y.*Z)*S^2*(S_v))/Z^3 - (2*\exp(-Z - Y.*Z)*S^2*(S_v))/Z^3 \dots \\
& + (11*S*(S_v))/(exp(3*Z)*Z^2) - (8*S*(S_v))/(exp(2*Z)*Z^2) + (2*S*(S_v))/(exp(Z)*Z^2) - (S*(S_v))/(exp(3.*Y.*Z)*Z^2) - (2*S*(S_v))/(exp(Y.*Z)*Z^2) \dots \\
& - (exp(-Z - 2.*Y.*Z)*S*(S_v))/Z^2 - (9*\exp(-2*Z - Y.*Z)*S*(S_v))/Z^2 + (8*\exp(-Z - Y.*Z)*S*(S_v))/Z^2 + (8*S^2*(S_v))/(exp(3*Z)*Z^2); \dots \\
& - (4*S^2*(S_v))/(exp(2*Z)*Z^2) + (S^2*(S_v))/(exp(Z)*Z^2) - (S^2*(S_v))/(exp(3.*Y.*Z)*Z^2) - (S^2*(S_v))/(exp(Y.*Z)*Z^2) - (exp(-Z - 2.*Y.*Z)*S^2*(S_v))/Z^2 \dots \\
& - (6*\exp(-2*Z - Y.*Z)*S^2*(S_v))/Z^2 + (4*\exp(-Z - Y.*Z)*S^2*(S_v))/Z^2 - (6*S.*Y.*(S_v))/(exp(3*Z)*Z^2) + (8*S.*Y.*(S_v))/(exp(2*Z)*Z^2) \dots \\
& - (2*S.*Y.*(S_v))/(exp(Z)*Z^2) + (2*S.*Y.*(S_v))/(exp(Y.*Z)*Z^2) + (6*\exp(-2*Z - Y.*Z)*S.*Y.*(S_v))/Z^2 - (8*\exp(-Z - Y.*Z)*S.*Y.*(S_v))/Z^2 \dots \\
& - (3*S^2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (4*S^2.*Y.*(S_v))/(exp(2*Z)*Z^2) - (S^2.*Y.*(S_v))/(exp(Z)*Z^2) + (S^2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) \dots \\
& + (3*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v))/Z^2 - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v))/Z^2 + (S*(S_v))/Z + (2*S*(S_v))/(exp(3*Z)*Z) + (9*S*(S_v))/(exp(2*Z)*Z) \dots \\
& - (4*S*(S_v))/(exp(Z)*Z) + (S*(S_v))/(exp(2.*Y.*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S*(S_v))/Z + (exp(-Z - Y.*Z)*S*(S_v))/Z + (2*S^2*(S_v))/(exp(3*Z)*Z) \dots \\
& + (S^2*(S_v))/(exp(2*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S^2*(S_v))/Z - (exp(-Z - Y.*Z)*S^2*(S_v))/Z - (2*S.*Y.*(S_v))/Z - (13*S.*Y.*(S_v))/(exp(2*Z)*Z) \dots \\
& + (8*S.*Y.*(S_v))/(exp(Z)*Z) - (S.*Y.*(S_v))/(exp(2.*Y.*Z)*Z) - (2*S^2.*Y.*(S_v))/(exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v))/Z + (S.*Y.^2*(S_v))/Z \dots \\
& + (3*S.*Y.^2*(S_v))/(exp(4*Z)*Z) - (4*S.*Y.^2*(S_v))/(exp(3*Z)*Z) + (4*S.*Y.^2*(S_v))/(exp(2*Z)*Z) - (4*S.*Y.^2*(S_v))/(exp(Z)*Z) \dots \\
& - (3*\exp(-3*Z - Y.*Z)*S.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S.*Y.^2*(S_v))/Z - (exp(-Z - Y.*Z)*S.*Y.^2*(S_v))/Z + (3*S^2.*Y.^2*(S_v))/(exp(4*Z)*Z) \dots \\
& - (4*S^2.*Y.^2*(S_v))/(exp(3*Z)*Z) + (S^2.*Y.^2*(S_v))/(exp(2*Z)*Z) - (3*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v))/Z \dots \\
& - (exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v))/Z - (3*S^2*(S_v))/(4*\exp(4*Z)) - (7*S^2*(S_v))/(4*\exp(2*Z)) - (3*S^2*(S_v))/(4*\exp(4*Z)) - (3*S^2*(S_v))/(4*\exp(2*Z)) \dots \\
& + (2*S.*Y.*Z*(S_v))/exp(2*Z) + (S^2.*Y.*Z*(S_v))/exp(2*Z) + (S.*Y.^2*(S_v))/exp(3*Z) + (3*S.*Y.^2*(S_v))/(2*\exp(2*Z)) + (S^2.*Y.^2*(S_v))/exp(3*Z) \dots \\
& + (S^2.*Y.^2*(S_v))/(2*\exp(2*Z)) - (2*S.*Y.^3*(S_v))/exp(2*Z) - (S^2.*Y.^3*(S_v))/exp(2*Z) + (3*S.*Y.^4*(S_v))/(4*\exp(4*Z)) - (S.*Y.^4*(S_v))/exp(3*Z) \dots \\
& + (S.*Y.^4*(S_v))/(4*\exp(2*Z)) + (3*S^2.*Y.^4*(S_v))/(4*\exp(4*Z)) - (S^2.*Y.^4*(S_v))/exp(3*Z) + (S^2.*Y.^4*(S_v))/(4*\exp(2*Z)) + (S^2.*Z^2*(S_v))/(2*\exp(3*Z)) \dots \\
& + (S^2.*Z^2*(S_v))/(2*\exp(3*Z)) - (S.*Y.^2*(S_v))/exp(3*Z) - (S^2.*Y.^2*(S_v))/exp(3*Z) + (S.*Y.^4*(S_v))/(2*\exp(3*Z)) \dots \\
& + (S^2.*Y.^4*(S_v))/(2*\exp(3*Z)) + (9*S^2*(S_v)^2)/(16*\exp(6*Z)) - (23*S^2*(S_v)^2)/(8*\exp(4*Z)) + (2*S^2*(S_v)^2)/exp(3*Z) + (S^2*(S_v)^2)/(16*\exp(2*Z)) \dots \\
& - (exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/2 - exp(-3*Z - Y.*Z)*S^2*(S_v)^2 - (2*S^2.*Y.*(S_v)^2)/exp(3*Z) - (S^2.*Y.*(S_v)^2)/exp(2*Z) + (9*S^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z)) \dots \\
& - (3*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^2*(S_v)^2)/(2*\exp(4*Z)) - (7*S^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z)) + (15*S^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z)) \dots \\
& + (exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/2 + exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2 - (3*S^2.*Y.^3*(S_v)^2)/exp(4*Z) + (4*S^2.*Y.^3*(S_v)^2)/exp(3*Z) \dots \\
& - (S^2.*Y.^3*(S_v)^2)/exp(2*Z) + (9*S^2.*Y.^4*(S_v)^2)/(16*\exp(6*Z)) - (3*S^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z)) \dots \\
& - (S^2.*Y.^4*(S_v)^2)/(2*\exp(3*Z)) + (S^2.*Y.^4*(S_v)^2)/(16*\exp(2*Z)) + (9*S^2*(S_v)^2)/(4*\exp(6*Z)*Z^4) - (6*S^2*(S_v)^2)/(exp(5*Z)*Z^4) \dots \\
& + (11*S^2*(S_v)^2)/(2*\exp(4*Z)*Z^4) - (2*S^2*(S_v)^2)/(exp(3*Z)*Z^4) + (S^2*(S_v)^2)/(4*\exp(2*Z)*Z^4) + (S^2*(S_v)^2)/(4*\exp(2.*Y.*Z)*Z^4) \dots \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^4 + (11*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^4) \dots \\
& - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^4) + (12*\exp(-4*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 \dots
\end{aligned}$$

$$\begin{aligned}
& + (4*\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z^4 - (\exp(-Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^4) + \\
& (12*S^2*(S_v)^2)/(\exp(5*Z)*Z^3) - (22*S^2*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& + (27*S^2*(S_v)^2)/(2*\exp(3*Z)*Z^3) - (4*S^2*(S_v)^2)/(\exp(2*Z)*Z^3) + \\
& (S^2*(S_v)^2)/(2*\exp(Z)*Z^3) - (S^2*(S_v)^2)/(2*\exp(3.*Y.*Z)*Z^3) ... \\
& - (S^2*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_v)^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/(2*Z^3) - (9*\exp(-4*Z \\
& - Y.*Z)*S^2*(S_v)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_v)^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_v)^2)/Z^3 - \\
& (9*S^2.*Y.*(S_v)^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& - (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^3) + (4*S^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z^3) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 ... \\
& - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v)^2)/Z^3 + (S^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (3*S^2*(S_v)^2)/(\exp(5*Z)*Z^2) + \\
& (19*S^2*(S_v)^2)/(\exp(4*Z)*Z^2) ... \\
& - (19*S^2*(S_v)^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_v)^2)/(\exp(Z)*Z^2) + (S^2*(S_v)^2)/(4*\exp(4.*Y.*Z)*Z^2) ... \\
& + (S^2*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S^2*(S_v)^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S^2*(S_v)^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/Z^2 ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_v)^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_v)^2)/Z^2 + (5*\exp(-3*Z \\
& - Y.*Z)*S^2*(S_v)^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z^2 ... \\
& + (\exp(-Z - Y.*Z)*S^2*(S_v)^2)/(4*Z^2) - (S^2.*Y.*(S_v)^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^2) ... \\
& - (29*S^2.*Y.*(S_v)^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_v)^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/Z^2 + (S^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_v)^2)/(\exp(5*Z)*Z^2) ... \\
& + (31*S^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_v)^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_v)^2)/(\exp(Z)*Z^2) ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z^2 - \\
& (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S^2*(S_v)^2)/(2*\exp(5*Z)*Z) - (S^2*(S_v)^2)/(\exp(4*Z)*Z) ... \\
& + (25*S^2*(S_v)^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_v)^2)/(\exp(2*Z)*Z) + (3*S^2*(S_v)^2)/(4*\exp(Z)*Z) \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z) ... \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_v)^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_v)^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_v)^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_v)^2)/Z ... \\
& - (9*S^2.*Y.*(S_v)^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z) ... \\
& - (7*S^2.*Y.*(S_v)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v)^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_v)^2)/Z + (15*S^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)*Z) ... \\
& - (13*S^2.*Y.^2*(S_v)^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_v)^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_v)^2)/(4*\exp(Z)*Z) ... \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/Z + \\
& (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v)^2)/(4*Z) ... \\
& - (9*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_v)^2)/(\exp(2*Z)*Z) ... \\
& - (S^2.*Y.^3*(S_v)^2)/(4*\exp(Z)*Z) - (3*S^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z)) - \\
& (3*S^2.*Y.^3*(S_v)^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_v)^2)/\exp(3*Z) + (S^2.*Y.^2.*Z*(S_v)^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^2.*Z*(S_v)^2)/(2*\exp(3*Z)) - (S^2.*Y.^3.*Z*(S_v)^2)/\exp(3*Z) + \\
& (3*S^2.*Y.^4.*Z*(S_v)^2)/(4*\exp(5*Z)) - (S^2.*Y.^4.*Z*(S_v)^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^4.*Z*(S_v)^2)/(4*\exp(3*Z)) + (S^2.*Z^2*(S_v)^2)/(4*\exp(4*Z)) - \\
& (S^2.*Y.^2.*Z^2*(S_v)^2)/(2*\exp(4*Z)) + (S^2.*Y.^4.*Z^2*(S_v)^2)/(4*\exp(4*Z));
\end{aligned}$$


```

Pe1=2;
Nc1=[1./Pe1^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns1=Nf+Nc1+Ny;
Phi1=Nf./[Nc1+Ny];
Be1=1./[1+Phi1];
Gf1=Nf./Ns1;
Gh1=[Nc1+Ny]./Ns1;
Nh1=Nc1+Ny;

```

```

Pe2=4;
Nc2=[1./Pe2^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns2=Nf+Nc2+Ny;
Phi2=Nf./[Nc2+Ny];
Be2=1./[1+Phi2];
Gf2=Nf./Ns2;
Gh2=[Nc2+Ny]./Ns2;
Nh2=Nc2+Ny;

```

```

Pe3=6;
Nc3=[1./Pe3^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns3=Nf+Nc3+Ny;
Phi3=Nf./[Nc3+Ny];
Be3=1./[1+Phi3];
Gf3=Nf./Ns3;
Gh3=[Nc3+Ny]./Ns3;
Nh3=Nc3+Ny;

```

```

Pe4=8;
Nc4=[1./Pe4^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns4=Nf+Nc4+Ny;
Phi4=Nf./[Nc4+Ny];
Be4=1./[1+Phi4];
Gf4=Nf./Ns4;
Gh4=[Nc4+Ny]./Ns4;
Nh4=Nc4+Ny;

```

```

Pe5=10;
Nc5=[1./Pe5^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns5=Nf+Nc5+Ny;
Phi5=Nf./[Nc5+Ny];
Be5=1./[1+Phi5];
Gf5=Nf./Ns5;
Gh5=[Nc5+Ny]./Ns5;
Nh5=Nc5+Ny;

```

```

plot(Y,Ns1,'b',Y,Ns2,'g',Y,Ns3,'r',Y,Ns4,'k',Y,Ns5,'m')

```

```

% plot(Y,Be1,'b',Y,Be2,'g',Y,Be3,'r',Y,Be4,'k',Y,Be5,'m')

```

```

% plot(Y,Phi1,'b',Y,Phi2,'g',Y,Phi3,'r',Y,Phi4,'k',Y,Phi5,'m')

```

```

% plot(Y,Gf1,'b',Y,Gf2,'g',Y,Gf3,'r',Y,Gf4,'k',Y,Gf5,'m')

% plot(Y,Gh1,'b',Y,Gh2,'g',Y,Gh3,'r',Y,Gh4,'k',Y,Gh5,'m')

% plot(Y,Nc1,'b',Y,Nc2,'g',Y,Nc3,'r',Y,Nc4,'k',Y,Nc5,'m')

% plot(Y,Nh1,'b',Y,Nh2,'g',Y,Nh3,'r',Y,Nh4,'k',Y,Nh5,'m')

% plot(Nh1,Nf,'b',Nh2,Nf,'g',Nh3,Nf,'r',Nh4,Nf,'k',Nh5,Nf,'m')

```

PLOTTOOLS ON

1.4. Distribution of $N_S, Be, \Phi, G_F, G_H, N_F$ and N_H versus Y for a range of S and set of S_v, Z, Br & Pe

```

S_v=1; Z=1; Br=1; Pe=2.5;
% S_v=2.5; Z=3.5; Br=0.5; Pe=5;

% % % % Z=2.5; S_v=3; Br=0.6; Pe=1;
% % % % Z=7.5; S_v=15; Br=0.6; Pe=2.5;
% % % % Z=5; S_v=0.75; Br=1; Pe=2;
% % % % Z=18; S_v=25; Br=0.9; Pe=5;

q=1.86;
s=1;
Dh=250*10^-6;
Y=0:0.005:1;

Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Nf=Br*[(Z^2).*exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];

S1=1;
Ny1=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S1)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S1 - S1^2/exp(2*Z) + exp(-Z - Y.*Z)*S1^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z).*Y.^2 ...
+ (2*S1.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S1.*Y.^2 + (S1^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S1^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1./(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z))/Z^2 + (2*S1)/(exp(2*Z)*Z^2) + (2*S1)./(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S1)/Z^2 + S1^2/(exp(2*Z)*Z^2) + S1^2./(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z)*S1^2)/Z^2 + 2/(exp(Z)*Z) - 2./(exp(Y.*Z)*Z) + (2*S1)/(exp(Z)*Z) - (2*S1)./(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...
- (2*S1.*Y)/(exp(Z)*Z) + (2*S1.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S1*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S1.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S1.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ...
- (S1.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S1*Z^2)/(2*exp(2*Z)) + (S1^2*Z^2)/(4*exp(2*Z)) - (Y.^2*Z^2)/(2*exp(2*Z)) - (S1.*Y.^2*Z^2)/exp(2*Z) ...
- (S1^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S1.*Y.^4*Z^2)/(2*exp(2*Z)) + (S1^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S1*(S_v))/(2*exp(3*Z)) ...
+ (2*S1*(S_v))/exp(2*Z) + (S1*(S_v))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S1*(S_v))/2 - (5*S1^2*(S_v))/exp(3*Z) + (2*S1^2*(S_v))/exp(2*Z) - (S1^2*(S_v))/(2*exp(Z)) ...
- (exp(-Z - 2.*Y.*Z)*S1^2*(S_v))/2 - (2*S1.*Y.*(S_v))/exp(2*Z) - (3*S1.*Y.*(S_v))/exp(Z) + (3*S1^2.*Y.*(S_v))/(2*exp(3*Z)) - (2*S1^2.*Y.*(S_v))/exp(2*Z) ...
+ (S1^2.*Y.*(S_v))/(2*exp(Z)) + (13*S1.*Y.^2*(S_v))/(2*exp(3*Z)) - (4*S1.*Y.^2*(S_v))/exp(2*Z) + (3*S1.*Y.^2*(S_v))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S1.*Y.^2*(S_v))/2 ...
+ (5*S1^2.*Y.^2*(S_v))/exp(3*Z) - (2*S1^2.*Y.^2*(S_v))/exp(2*Z) + (S1^2.*Y.^2*(S_v))/(2*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S1^2.*Y.^2*(S_v))/2 - (3*S1.*Y.^3*(S_v))/exp(3*Z) ...
+ (4*S1.*Y.^3*(S_v))/exp(2*Z) - (S1.*Y.^3*(S_v))/exp(Z) - (3*S1^2.*Y.^3*(S_v))/(2*exp(3*Z)) + (2*S1^2.*Y.^3*(S_v))/exp(2*Z) - (S1^2.*Y.^3*(S_v))/(2*exp(Z)) ...
+ (3*S1*(S_v))/(exp(4*Z)*Z^3) - (4*S1*(S_v))/(exp(3*Z)*Z^3) + (S1*(S_v))/(exp(2*Z)*Z^3) + (S1*(S_v))./(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S1*(S_v))/Z^3 ...
- (4*exp(-Z - 2.*Y.*Z)*S1*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S1*(S_v))/Z^3 + (8*exp(-2*Z - Y.*Z)*S1*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S1*(S_v))/Z^3 ...

```

$$\begin{aligned}
& + (3*S1^2*(S_v))/(exp(4*Z)*Z^3) - (4*S1^2*(S_v))/(exp(3*Z)*Z^3) + (S1^2*(S_v))/(exp(2*Z)*Z^3) + \\
& (S1^2*(S_v))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S1^2*(S_v))/Z^3 ... \\
& - (4*exp(-Z - 2.*Y.*Z)*S1^2*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S1^2*(S_v))/Z^3 + (8*exp(-2*Z - \\
& Y.*Z)*S1^2*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S1^2*(S_v))/Z^3 ... \\
& + (11*S1*(S_v))/(exp(3*Z)*Z^2) - (8*S1*(S_v))/(exp(2*Z)*Z^2) + (2*S1*(S_v))/(exp(Z)*Z^2) - \\
& (S1*(S_v))/(exp(3.*Y.*Z)*Z^2) - (2*S1*(S_v))/(exp(Y.*Z)*Z^2) ... \\
& - (exp(-Z - 2.*Y.*Z)*S1*(S_v))/Z^2 - (9*exp(-2*Z - Y.*Z)*S1*(S_v))/Z^2 + (8*exp(-Z - \\
& Y.*Z)*S1*(S_v))/Z^2 + (8*S1^2*(S_v))/(exp(3*Z)*Z^2); ... \\
& - (4*S1^2*(S_v))/(exp(2*Z)*Z^2) + (S1^2*(S_v))/(exp(Z)*Z^2) - (S1^2*(S_v))/(exp(3.*Y.*Z)*Z^2) - \\
& (S1^2*(S_v))/(exp(Y.*Z)*Z^2) - (exp(-Z - 2.*Y.*Z)*S1^2*(S_v))/Z^2 ... \\
& - (6*exp(-2*Z - Y.*Z)*S1^2*(S_v))/Z^2 + (4*exp(-Z - Y.*Z)*S1^2*(S_v))/Z^2 - \\
& (6*S1.*Y.*(S_v))/(exp(3*Z)*Z^2) + (8*S1.*Y.*(S_v))/(exp(2*Z)*Z^2) ... \\
& - (2*S1.*Y.*(S_v))/(exp(Z)*Z^2) + (2*S1.*Y.*(S_v))/(exp(Y.*Z)*Z^2) + (6*exp(-2*Z - \\
& Y.*Z)*S1.*Y.*(S_v))/Z^2 - (8*exp(-Z - Y.*Z)*S1.*Y.*(S_v))/Z^2 ... \\
& - (3*S1^2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (4*S1^2.*Y.*(S_v))/(exp(2*Z)*Z^2) - \\
& (S1^2.*Y.*(S_v))/(exp(Z)*Z^2) + (S1^2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) ... \\
& + (3*exp(-2*Z - Y.*Z)*S1^2.*Y.*(S_v))/Z^2 - (4*exp(-Z - Y.*Z)*S1^2.*Y.*(S_v))/Z^2 + (S1*(S_v))/Z \\
& + (2*S1*(S_v))/(exp(3*Z)*Z) + (9*S1*(S_v))/(exp(2*Z)*Z) ... \\
& - (4*S1*(S_v))/(exp(Z)*Z) + (S1*(S_v))/(exp(2.*Y.*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S1*(S_v))/Z + \\
& (exp(-Z - Y.*Z)*S1*(S_v))/Z + (2*S1^2*(S_v))/(exp(3*Z)*Z) ... \\
& + (S1^2*(S_v))/(exp(2*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S1^2*(S_v))/Z - (exp(-Z - Y.*Z)*S1^2*(S_v))/Z - \\
& (2*S1.*Y.*(S_v))/Z - (13*S1.*Y.*(S_v))/(exp(2*Z)*Z) ... \\
& + (8*S1.*Y.*(S_v))/(exp(Z)*Z) - (S1.*Y.*(S_v))/(exp(2.*Y.*Z)*Z) - \\
& (2*S1^2.*Y.*(S_v))/(exp(2*Z)*Z) + (2*exp(-Z - Y.*Z)*S1^2.*Y.*(S_v))/Z + (S1.*Y.^2*(S_v))/Z ... \\
& + (3*S1.*Y.^2*(S_v))/(exp(4*Z)*Z) - (4*S1.*Y.^2*(S_v))/(exp(3*Z)*Z) + \\
& (4*S1.*Y.^2*(S_v))/(exp(2*Z)*Z) - (4*S1.*Y.^2*(S_v))/(exp(Z)*Z) ... \\
& - (3*exp(-3*Z - Y.*Z)*S1.*Y.^2*(S_v))/Z + (4*exp(-2*Z - Y.*Z)*S1.*Y.^2*(S_v))/Z - (exp(-Z - \\
& Y.*Z)*S1.*Y.^2*(S_v))/Z + (3*S1^2.*Y.^2*(S_v))/(exp(4*Z)*Z) ... \\
& - (4*S1^2.*Y.^2*(S_v))/(exp(3*Z)*Z) + (S1^2.*Y.^2*(S_v))/(exp(2*Z)*Z) - (3*exp(-3*Z - \\
& Y.*Z)*S1^2.*Y.^2*(S_v))/Z + (4*exp(-2*Z - Y.*Z)*S1^2.*Y.^2*(S_v))/Z ... \\
& - (exp(-Z - Y.*Z)*S1^2.*Y.^2*(S_v))/Z - (3*S1^2*Z*(S_v))/(4*exp(4*Z)) - (7*S1^2*Z*(S_v))/(4*exp(2*Z)) \\
& - (3*S1^2*Z*(S_v))/(4*exp(4*Z)) - (3*S1^2*Z*(S_v))/(4*exp(2*Z)) ... \\
& + (2*S1.*Y.*Z*(S_v))/exp(2*Z) + (S1^2.*Y.*Z*(S_v))/exp(2*Z) + (S1.*Y.^2*Z*(S_v))/exp(3*Z) + \\
& (3*S1.*Y.^2*Z*(S_v))/(2*exp(2*Z)) + (S1^2.*Y.^2*Z*(S_v))/exp(3*Z) ... \\
& + (S1^2.*Y.^2*Z*(S_v))/(2*exp(2*Z)) - (2*S1.*Y.^3*Z*(S_v))/exp(2*Z) - \\
& (S1^2.*Y.^3*Z*(S_v))/exp(2*Z) + (3*S1.*Y.^4*Z*(S_v))/(4*exp(4*Z)) - (S1.*Y.^4*Z*(S_v))/exp(3*Z) \\
& ... \\
& + (S1.*Y.^4*Z*(S_v))/(4*exp(2*Z)) + (3*S1^2.*Y.^4*Z*(S_v))/(4*exp(4*Z)) - \\
& (S1^2.*Y.^4*Z*(S_v))/exp(3*Z) + (S1^2.*Y.^4*Z*(S_v))/(4*exp(2*Z)) + (S1^2*Z^2*(S_v))/(2*exp(3*Z)) \\
& ... \\
& + (S1^2*Z^2*(S_v))/(2*exp(3*Z)) - (S1.*Y.^2*Z^2*(S_v))/exp(3*Z) - \\
& (S1^2.*Y.^2*Z^2*(S_v))/exp(3*Z) + (S1.*Y.^4*Z^2*(S_v))/(2*exp(3*Z)) ... \\
& + (S1^2.*Y.^4*Z^2*(S_v))/(2*exp(3*Z)) + (9*S1^2*(S_v)^2)/(16*exp(6*Z)) - \\
& (23*S1^2*(S_v)^2)/(8*exp(4*Z)) + (2*S1^2*(S_v)^2)/exp(3*Z) + (S1^2*(S_v)^2)/(16*exp(2*Z)) ... \\
& - (exp(-2*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/2 - exp(-3*Z - Y.*Z)*S1^2*(S_v)^2 - \\
& (2*S1^2.*Y.*(S_v)^2)/exp(3*Z) - (S1^2.*Y.*(S_v)^2)/exp(2*Z) + (9*S1^2.*Y.^2*(S_v)^2)/(8*exp(6*Z)) \\
& ... \\
& - (3*S1^2.*Y.^2*(S_v)^2)/(2*exp(5*Z)) + (11*S1^2.*Y.^2*(S_v)^2)/(2*exp(4*Z)) - \\
& (7*S1^2.*Y.^2*(S_v)^2)/(2*exp(3*Z)) + (15*S1^2.*Y.^2*(S_v)^2)/(8*exp(2*Z)) ... \\
& + (exp(-2*Z - 2.*Y.*Z)*S1^2.*Y.^2*(S_v)^2)/2 + exp(-3*Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2 - \\
& (3*S1^2.*Y.^3*(S_v)^2)/exp(4*Z) + (4*S1^2.*Y.^3*(S_v)^2)/exp(3*Z) ... \\
& - (S1^2.*Y.^3*(S_v)^2)/exp(2*Z) + (9*S1^2.*Y.^4*(S_v)^2)/(16*exp(6*Z)) - \\
& (3*S1^2.*Y.^4*(S_v)^2)/(2*exp(5*Z)) + (11*S1^2.*Y.^4*(S_v)^2)/(8*exp(4*Z)) ... \\
& - (S1^2.*Y.^4*(S_v)^2)/(2*exp(3*Z)) + (S1^2.*Y.^4*(S_v)^2)/(16*exp(2*Z)) + \\
& (9*S1^2*(S_v)^2)/(4*exp(6*Z)*Z^4) - (6*S1^2*(S_v)^2)/(exp(5*Z)*Z^4) ...
\end{aligned}$$

$$\begin{aligned}
& + (11*S1^2*(S_v)^2)/(2*\exp(4*Z)*Z^4) - (2*S1^2*(S_v)^2)/(\exp(3*Z)*Z^4) + \\
& (S1^2*(S_v)^2)/(4*\exp(2*Z)*Z^4) + (S1^2*(S_v)^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z)*S1^2*(S_v)^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S1^2*(S_v)^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S1^2*(S_v)^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S1^2*(S_v)^2)/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z)*S1^2*(S_v)^2)/Z^4 - (\exp(-Z - Y.*Z)*S1^2*(S_v)^2)/(2*Z^4) + \\
& (12*S1^2*(S_v)^2)/(\exp(5*Z)*Z^3) - (22*S1^2*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& + (27*S1^2*(S_v)^2)/(2*\exp(3*Z)*Z^3) - (4*S1^2*(S_v)^2)/(\exp(2*Z)*Z^3) + \\
& (S1^2*(S_v)^2)/(2*\exp(Z)*Z^3) - (S1^2*(S_v)^2)/(2*\exp(3.*Y.*Z)*Z^3) ... \\
& - (S1^2*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S1^2*(S_v)^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S1^2*(S_v)^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S1^2*(S_v)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S1^2*(S_v)^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S1^2*(S_v)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S1^2*(S_v)^2)/Z^3 - \\
& (9*S1^2.*Y.*(S_v)^2)/(2*\exp(5*Z)*Z^3) + (12*S1^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& - (11*S1^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^3) + (4*S1^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z^3) - \\
& (S1^2.*Y.*(S_v)^2)/(2*\exp(Z)*Z^3) + (S1^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S1^2.*Y.*(S_v)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S1^2.*Y.*(S_v)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S1^2.*Y.*(S_v)^2)/Z^3 ... \\
& - (4*\exp(-Z - Y.*Z)*S1^2.*Y.*(S_v)^2)/Z^3 + (S1^2*(S_v)^2)/(4*Z^2) + \\
& (9*S1^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (3*S1^2*(S_v)^2)/(\exp(5*Z)*Z^2) + \\
& (19*S1^2*(S_v)^2)/(\exp(4*Z)*Z^2) ... \\
& - (19*S1^2*(S_v)^2)/(\exp(3*Z)*Z^2) + (35*S1^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S1^2*(S_v)^2)/(\exp(Z)*Z^2) + (S1^2*(S_v)^2)/(4*\exp(4.*Y.*Z)*Z^2) ... \\
& + (S1^2*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S1^2*(S_v)^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S1^2*(S_v)^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S1^2*(S_v)^2)/Z^2 ... \\
& - (9*\exp(-5*Z - Y.*Z)*S1^2*(S_v)^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S1^2*(S_v)^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S1^2*(S_v)^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S1^2*(S_v)^2)/Z^2 ... \\
& + (\exp(-Z - Y.*Z)*S1^2*(S_v)^2)/(4*Z^2) - (S1^2.*Y.*(S_v)^2)/(2*Z^2) - \\
& (15*S1^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^2) + (26*S1^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^2) ... \\
& - (29*S1^2.*Y.*(S_v)^2)/(2*\exp(2*Z)*Z^2) + (4*S1^2.*Y.*(S_v)^2)/(\exp(Z)*Z^2) - \\
& (S1^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S1^2.*Y.*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-Z - 2.*Y.*Z)*S1^2.*Y.*(S_v)^2)/Z^2 + (S1^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S1^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (6*S1^2.*Y.^2*(S_v)^2)/(\exp(5*Z)*Z^2) ... \\
& + (31*S1^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z)*Z^2) - (8*S1^2.*Y.^2*(S_v)^2)/(\exp(3*Z)*Z^2) + \\
& (23*S1^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - (2*S1^2.*Y.^2*(S_v)^2)/(\exp(Z)*Z^2) ... \\
& - (9*\exp(-5*Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2)/(2*Z^2) ... \\
& + (2*\exp(-2*Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2)/Z^2 - (\exp(-Z - Y.*Z)*S1^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S1^2*(S_v)^2)/(2*\exp(5*Z)*Z) - (S1^2*(S_v)^2)/(\exp(4*Z)*Z) ... \\
& + (25*S1^2*(S_v)^2)/(4*\exp(3*Z)*Z) - (3*S1^2*(S_v)^2)/(\exp(2*Z)*Z) + \\
& (3*S1^2*(S_v)^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(4*Z) ... \\
& + (3*\exp(-Z - 2.*Y.*Z)*S1^2*(S_v)^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S1^2*(S_v)^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S1^2*(S_v)^2)/Z + (2*\exp(-2*Z - Y.*Z)*S1^2*(S_v)^2)/Z ... \\
& - (9*S1^2.*Y.*(S_v)^2)/(4*\exp(5*Z)*Z) + (3*S1^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S1^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z) + (7*S1^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z) ... \\
& - (7*S1^2.*Y.*(S_v)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S1^2.*Y.*(S_v)^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S1^2.*Y.*(S_v)^2)/Z + (15*S1^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)*Z) ... \\
& - (13*S1^2.*Y.^2*(S_v)^2)/(\exp(4*Z)*Z) + (41*S1^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z)*Z) - \\
& (6*S1^2.*Y.^2*(S_v)^2)/(\exp(2*Z)*Z) + (5*S1^2.*Y.^2*(S_v)^2)/(4*\exp(Z)*Z) ... \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S1^2.*Y.^2*(S_v)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S1^2.*Y.^2*(S_v)^2)/Z \\
& + (\exp(-Z - 2.*Y.*Z)*S1^2.*Y.^2*(S_v)^2)/(4*Z) ... \\
& - (9*S1^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z)*Z) + (6*S1^2.*Y.^3*(S_v)^2)/(\exp(4*Z)*Z) - \\
& (11*S1^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z)*Z) + (2*S1^2.*Y.^3*(S_v)^2)/(\exp(2*Z)*Z) ...
\end{aligned}$$

$$\begin{aligned}
& - \frac{(S1^2.*Y.^3*(S_v)^2)/(4*\exp(Z)*Z)}{(3*S1^2*Z*(S_v)^2)/(4*\exp(3*Z))} - \frac{(3*S1^2*Z*(S_v)^2)/(4*\exp(5*Z))}{(S1^2.*Y.*Z*(S_v)^2/\exp(3*Z))} - \\
& (S1^2.*Y.^2*Z*(S_v)^2)/\exp(4*Z) \dots + \frac{(S1^2.*Y.^2*Z*(S_v)^2)/(2*\exp(3*Z))}{(3*S1^2.*Y.^4*Z*(S_v)^2)/(4*\exp(5*Z))} - \frac{(S1^2.*Y.^3*Z*(S_v)^2)/\exp(3*Z)}{(S1^2.*Y.^4*Z*(S_v)^2)/\exp(4*Z) \dots} + \\
& + \frac{(S1^2.*Y.^4*Z*(S_v)^2)/(4*\exp(3*Z))}{(S1^2.*Z^2*(S_v)^2)/(4*\exp(4*Z))} - \frac{(S1^2.*Z^2*(S_v)^2)/(4*\exp(4*Z))}{(S1^2.*Y.^2*Z^2*(S_v)^2)/(2*\exp(4*Z)) + (S1^2.*Y.^4*Z^2*(S_v)^2)/(4*\exp(4*Z))};
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf + Nc + Ny1; \\
Phi1 &= Nf./[Nc + Ny1]; \\
Be1 &= 1./[1 + Phi1]; \\
Gf1 &= Nf./Ns1; \\
Gh1 &= [Nc + Ny1]./Ns1; \\
Nh1 &= Nc + Ny1;
\end{aligned}$$

$$S2=2;$$

$$\begin{aligned}
Ny2 &= 1 - \exp(-2*Z) + \exp(-Z - Y.*Z) - (2*S2)/\exp(2*Z) + 2*\exp(-Z - Y.*Z)*S2 - S2^2/\exp(2*Z) + \exp(-Z - Y.*Z)*S2^2 - 2.*Y + Y.^2 + Y.^2/\exp(2*Z) - \exp(-Z - Y.*Z)*Y.^2 \dots \\
& + (2*S2.*Y.^2)/\exp(2*Z) - 2*\exp(-Z - Y.*Z)*S2.*Y.^2 + (S2^2.*Y.^2)/\exp(2*Z) - \exp(-Z - Y.*Z)*S2^2.*Y.^2 + 1/(\exp(2*Z)*Z^2) + 1/(\exp(2.*Y.*Z)*Z^2) \dots \\
& - (2*\exp(-Z - Y.*Z))/Z^2 + (2*S2)/(\exp(2*Z)*Z^2) + (2*S2)/(\exp(2.*Y.*Z)*Z^2) - (4*\exp(-Z - Y.*Z)*S2)/Z^2 + S2^2/(\exp(2*Z)*Z^2) + S2^2./(\exp(2.*Y.*Z)*Z^2) \dots \\
& - (2*\exp(-Z - Y.*Z)*S2^2)/Z^2 + 2/(\exp(Z)*Z) - 2./(\exp(Y.*Z)*Z) + (2*S2)/(\exp(Z)*Z) - (2*S2)/(\exp(Y.*Z)*Z) - (2.*Y)/(\exp(Z)*Z) + (2.*Y)/(\exp(Y.*Z)*Z) \dots \\
& - (2*S2.*Y)/(\exp(Z)*Z) + (2*S2.*Y)/(\exp(Y.*Z)*Z) - Z/\exp(Z) - (S2*Z)/\exp(Z) + (Y.*Z)/\exp(Z) + (S2.*Y.*Z)/\exp(Z) + (Y.^2*Z)/\exp(Z) + (S2.*Y.^2*Z)/\exp(Z) - (Y.^3*Z)/\exp(Z) \dots \\
& - (S2.*Y.^3*Z)/\exp(Z) + Z^2/(4*\exp(2*Z)) + (S2*Z^2)/(2*\exp(2*Z)) + (S2^2*Z^2)/(4*\exp(2*Z)) - (Y.^2*Z^2)/(2*\exp(2*Z)) - (S2.*Y.^2*Z^2)/\exp(2*Z) \dots \\
& - (S2^2.*Y.^2*Z^2)/(2*\exp(2*Z)) + (Y.^4*Z^2)/(4*\exp(2*Z)) + (S2.*Y.^4*Z^2)/(2*\exp(2*Z)) + (S2^2.*Y.^4*Z^2)/(4*\exp(2*Z)) - (7*S2*(S_v))/(2*\exp(3*Z)) \dots \\
& + (2*S2*(S_v))/\exp(2*Z) + (S2*(S_v))/\exp(Z) - (\exp(-Z - 2.*Y.*Z)*S2*(S_v))/2 - (5*S2^2*(S_v))/\exp(3*Z) + (2*S2^2*(S_v))/\exp(2*Z) - (S2^2*(S_v))/(2*\exp(Z)) \dots \\
& - (\exp(-Z - 2.*Y.*Z)*S2^2*(S_v))/2 - (2*S2.*Y*(S_v))/\exp(2*Z) - (3*S2.*Y*(S_v))/\exp(Z) + (3*S2^2.*Y*(S_v))/(2*\exp(3*Z)) - (2*S2^2.*Y*(S_v))/\exp(2*Z) \dots \\
& + (S2^2.*Y*(S_v))/(2*\exp(Z)) + (13*S2.*Y.^2*(S_v))/(2*\exp(3*Z)) - (4*S2.*Y.^2*(S_v))/\exp(2*Z) + (3*S2.*Y.^2*(S_v))/\exp(Z) + (\exp(-Z - 2.*Y.*Z)*S2.*Y.^2*(S_v))/2 \dots \\
& + (5*S2^2.*Y.^2*(S_v))/\exp(3*Z) - (2*S2^2.*Y.^2*(S_v))/\exp(2*Z) + (S2^2.*Y.^2*(S_v))/(2*\exp(Z)) + (\exp(-Z - 2.*Y.*Z)*S2^2.*Y.^2*(S_v))/2 - (3*S2.*Y.^3*(S_v))/\exp(3*Z) \dots \\
& + (4*S2.*Y.^3*(S_v))/\exp(2*Z) - (S2.*Y.^3*(S_v))/\exp(Z) - (3*S2^2.*Y.^3*(S_v))/(2*\exp(3*Z)) + (2*S2^2.*Y.^3*(S_v))/\exp(2*Z) - (S2^2.*Y.^3*(S_v))/(2*\exp(Z)) \dots \\
& + (3*S2*(S_v))/(\exp(4*Z)*Z^3) - (4*S2*(S_v))/(\exp(3*Z)*Z^3) + (S2*(S_v))/(\exp(2*Z)*Z^3) + (S2*(S_v))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S2*(S_v))/Z^3 \dots \\
& - (4*\exp(-Z - 2.*Y.*Z)*S2*(S_v))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S2*(S_v))/Z^3 + (8*\exp(-2*Z - Y.*Z)*S2*(S_v))/Z^3 - (2*\exp(-Z - Y.*Z)*S2*(S_v))/Z^3 \dots \\
& + (3*S2^2*(S_v))/(\exp(4*Z)*Z^3) - (4*S2^2*(S_v))/(\exp(3*Z)*Z^3) + (S2^2*(S_v))/(\exp(2*Z)*Z^3) + (S2^2*(S_v))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S2^2*(S_v))/Z^3 \dots \\
& - (4*\exp(-Z - 2.*Y.*Z)*S2^2*(S_v))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S2^2*(S_v))/Z^3 + (8*\exp(-2*Z - Y.*Z)*S2^2*(S_v))/Z^3 - (2*\exp(-Z - Y.*Z)*S2^2*(S_v))/Z^3 \dots \\
& + (11*S2*(S_v))/(\exp(3*Z)*Z^2) - (8*S2*(S_v))/(\exp(2*Z)*Z^2) + (2*S2*(S_v))/(\exp(Z)*Z^2) - (S2*(S_v))/(\exp(3.*Y.*Z)*Z^2) - (2*S2*(S_v))/(\exp(Y.*Z)*Z^2) \dots \\
& - (\exp(-Z - 2.*Y.*Z)*S2*(S_v))/Z^2 - (9*\exp(-2*Z - Y.*Z)*S2*(S_v))/Z^2 + (8*\exp(-Z - Y.*Z)*S2*(S_v))/Z^2 + (8*S2^2*(S_v))/(\exp(3*Z)*Z^2); \dots \\
& - (4*S2^2*(S_v))/(\exp(2*Z)*Z^2) + (S2^2*(S_v))/(\exp(Z)*Z^2) - (S2^2*(S_v))/(\exp(3.*Y.*Z)*Z^2) - (S2^2*(S_v))/(\exp(Y.*Z)*Z^2) - (\exp(-Z - 2.*Y.*Z)*S2^2*(S_v))/Z^2 \dots
\end{aligned}$$

$$\begin{aligned}
& - (6*\exp(-2*Z - Y.*Z))*S2^2*(S_v))/Z^2 + (4*\exp(-Z - Y.*Z))*S2^2*(S_v))/Z^2 - \\
& (6*S2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (8*S2.*Y.*(S_v))/(exp(2*Z)*Z^2) ... \\
& - (2*S2.*Y.*(S_v))/(exp(Z)*Z^2) + (2*S2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) + (6*\exp(-2*Z - \\
& Y.*Z))*S2.*Y.*(S_v))/Z^2 - (8*\exp(-Z - Y.*Z))*S2.*Y.*(S_v))/Z^2 ... \\
& - (3*S2^2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (4*S2^2.*Y.*(S_v))/(exp(2*Z)*Z^2) - \\
& (S2^2.*Y.*(S_v))/(exp(Z)*Z^2) + (S2^2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) ... \\
& + (3*\exp(-2*Z - Y.*Z))*S2^2.*Y.*(S_v))/Z^2 - (4*\exp(-Z - Y.*Z))*S2^2.*Y.*(S_v))/Z^2 + (S2*(S_v))/Z \\
& + (2*S2*(S_v))/(exp(3*Z)*Z) + (9*S2*(S_v))/(exp(2*Z)*Z) ... \\
& - (4*S2*(S_v))/(exp(Z)*Z) + (S2*(S_v))/(exp(2.*Y.*Z)*Z) - (2*\exp(-2*Z - Y.*Z))*S2*(S_v))/Z + \\
& (exp(-Z - Y.*Z))*S2*(S_v))/Z + (2*S2^2*(S_v))/(exp(3*Z)*Z) ... \\
& + (S2^2*(S_v))/(exp(2*Z)*Z) - (2*\exp(-2*Z - Y.*Z))*S2^2*(S_v))/Z - (exp(-Z - Y.*Z))*S2^2*(S_v))/Z - \\
& (2*S2.*Y.*(S_v))/Z - (13*S2.*Y.*(S_v))/(exp(2*Z)*Z) ... \\
& + (8*S2.*Y.*(S_v))/(exp(Z)*Z) - (S2.*Y.*(S_v))/(exp(2.*Y.*Z)*Z) - \\
& (2*S2^2.*Y.*(S_v))/(exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z))*S2^2.*Y.*(S_v))/Z + (S2.*Y.^2*(S_v))/Z ... \\
& + (3*S2.*Y.^2*(S_v))/(exp(4*Z)*Z) - (4*S2.*Y.^2*(S_v))/(exp(3*Z)*Z) + \\
& (4*S2.*Y.^2*(S_v))/(exp(2*Z)*Z) - (4*S2.*Y.^2*(S_v))/(exp(Z)*Z) ... \\
& - (3*\exp(-3*Z - Y.*Z))*S2.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z))*S2.*Y.^2*(S_v))/Z - (exp(-Z - \\
& Y.*Z))*S2.*Y.^2*(S_v))/Z + (3*S2^2.*Y.^2*(S_v))/(exp(4*Z)*Z) ... \\
& - (4*S2^2.*Y.^2*(S_v))/(exp(3*Z)*Z) + (S2^2.*Y.^2*(S_v))/(exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z))*S2^2.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z))*S2^2.*Y.^2*(S_v))/Z ... \\
& - (exp(-Z - Y.*Z))*S2^2.*Y.^2*(S_v))/Z - (3*S2^2*(S_v))/(4*\exp(4*Z)) - (7*S2^2*(S_v))/(4*\exp(2*Z)) \\
& - (3*S2^2*(S_v))/(4*\exp(4*Z)) - (3*S2^2*(S_v))/(4*\exp(2*Z)) ... \\
& + (2*S2.*Y.*Z*(S_v))/exp(2*Z) + (S2^2.*Y.*Z*(S_v))/exp(2*Z) + (S2.*Y.^2*(S_v))/exp(3*Z) + \\
& (3*S2.*Y.^2*(S_v))/(2*\exp(2*Z)) + (S2^2.*Y.^2*(S_v))/exp(3*Z) ... \\
& + (S2^2.*Y.^2*(S_v))/(2*\exp(2*Z)) - (2*S2.*Y.^3*(S_v))/exp(2*Z) - \\
& (S2^2.*Y.^3*(S_v))/exp(2*Z) + (3*S2.*Y.^4*(S_v))/(4*\exp(4*Z)) - (S2.*Y.^4*(S_v))/exp(3*Z) \\
& ... \\
& + (S2.*Y.^4*(S_v))/(4*\exp(2*Z)) + (3*S2^2.*Y.^4*(S_v))/(4*\exp(4*Z)) - \\
& (S2^2.*Y.^4*(S_v))/exp(3*Z) + (S2^2.*Y.^4*(S_v))/(4*\exp(2*Z)) + (S2^2*(S_v))/(2*\exp(3*Z)) \\
& ... \\
& + (S2^2*(S_v))/(2*\exp(3*Z)) - (S2.*Y.^2*(S_v))/exp(3*Z) - \\
& (S2^2.*Y.^2*(S_v))/exp(3*Z) + (S2.*Y.^4*(S_v))/(2*\exp(3*Z)) ... \\
& + (S2^2.*Y.^4*(S_v))/(2*\exp(3*Z)) + (9*S2^2*(S_v)^2)/(16*\exp(6*Z)) - \\
& (23*S2^2*(S_v)^2)/(8*\exp(4*Z)) + (2*S2^2*(S_v)^2)/exp(3*Z) + (S2^2*(S_v)^2)/(16*\exp(2*Z)) ... \\
& - (exp(-2*Z - 2.*Y.*Z))*S2^2*(S_v)^2/2 - exp(-3*Z - Y.*Z))*S2^2*(S_v)^2 - \\
& (2*S2^2.*Y.*(S_v)^2)/exp(3*Z) - (S2^2.*Y.*(S_v)^2)/exp(2*Z) + (9*S2^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z)) \\
& ... \\
& - (3*S2^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)) + (11*S2^2.*Y.^2*(S_v)^2)/(2*\exp(4*Z)) - \\
& (7*S2^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z)) + (15*S2^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z)) ... \\
& + (exp(-2*Z - 2.*Y.*Z))*S2^2.*Y.^2*(S_v)^2/2 + exp(-3*Z - Y.*Z))*S2^2.*Y.^2*(S_v)^2 - \\
& (3*S2^2.*Y.^3*(S_v)^2)/exp(4*Z) + (4*S2^2.*Y.^3*(S_v)^2)/exp(3*Z) ... \\
& - (S2^2.*Y.^3*(S_v)^2)/exp(2*Z) + (9*S2^2.*Y.^4*(S_v)^2)/(16*\exp(6*Z)) - \\
& (3*S2^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z)) + (11*S2^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z)) ... \\
& - (S2^2.*Y.^4*(S_v)^2)/(2*\exp(3*Z)) + (S2^2.*Y.^4*(S_v)^2)/(16*\exp(2*Z)) + \\
& (9*S2^2*(S_v)^2)/(4*\exp(6*Z)*Z^4) - (6*S2^2*(S_v)^2)/(exp(5*Z)*Z^4) ... \\
& + (11*S2^2*(S_v)^2)/(2*\exp(4*Z)*Z^4) - (2*S2^2*(S_v)^2)/(exp(3*Z)*Z^4) + \\
& (S2^2*(S_v)^2)/(4*\exp(2*Z)*Z^4) + (S2^2*(S_v)^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z))*S2^2*(S_v)^2/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z))*S2^2*(S_v)^2/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z))*S2^2*(S_v)^2/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z))*S2^2*(S_v)^2/Z^4 - (9*\exp(-5*Z - Y.*Z))*S2^2*(S_v)^2/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z))*S2^2*(S_v)^2/Z^4 - (11*\exp(-3*Z - Y.*Z))*S2^2*(S_v)^2/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z))*S2^2*(S_v)^2/Z^4 - (exp(-Z - Y.*Z))*S2^2*(S_v)^2/(2*Z^4) + \\
& (12*S2^2*(S_v)^2)/(exp(5*Z)*Z^3) - (22*S2^2*(S_v)^2)/(exp(4*Z)*Z^3) ... \\
& + (27*S2^2*(S_v)^2)/(2*\exp(3*Z)*Z^3) - (4*S2^2*(S_v)^2)/(exp(2*Z)*Z^3) + \\
& (S2^2*(S_v)^2)/(2*\exp(Z)*Z^3) - (S2^2*(S_v)^2)/(2*\exp(3.*Y.*Z)*Z^3) ...
\end{aligned}$$

Gf2=Nf./Ns2;
 Gh2=[Nc+Ny2]./Ns2;
 Nh2=Nc+Ny2;

S3=3;
 Ny3=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S3)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S3 - S3^2/exp(2*Z) + exp(-Z - Y.*Z)*S3^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z)*Y.^2 ...
 + (2*S3.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S3.*Y.^2 + (S3^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S3^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ...
 - (2*exp(-Z - Y.*Z))/Z^2 + (2*S3)/(exp(2*Z)*Z^2) + (2*S3)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S3)/Z^2 + S3^2/(exp(2*Z)*Z^2) + S3^2./(exp(2.*Y.*Z)*Z^2) ...
 - (2*exp(-Z - Y.*Z)*S3^2)/Z^2 + 2/(exp(Z)*Z) - 2/(exp(Y.*Z)*Z) + (2*S3)/(exp(Z)*Z) - (2*S3)/(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...
 - (2*S3.*Y)/(exp(Z)*Z) + (2*S3.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S3*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S3.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S3.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ...
 - (S3.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S3*Z^2)/(2*exp(2*Z)) + (S3^2*Z^2)/(4*exp(2*Z)) - (Y.^2*Z^2)/(2*exp(2*Z)) - (S3.*Y.^2*Z^2)/exp(2*Z) ...
 - (S3^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S3.*Y.^4*Z^2)/(2*exp(2*Z)) + (S3^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S3*(S_v))/(2*exp(3*Z)) ...
 + (2*S3*(S_v))/exp(2*Z) + (S3*(S_v))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S3*(S_v))/2 - (5*S3^2*(S_v))/exp(3*Z) + (2*S3^2*(S_v))/exp(2*Z) - (S3^2*(S_v))/(2*exp(Z)) ...
 - (exp(-Z - 2.*Y.*Z)*S3^2*(S_v))/2 - (2*S3.*Y.*(S_v))/exp(2*Z) - (3*S3.*Y.*(S_v))/exp(Z) + (3*S3^2.*Y.*(S_v))/(2*exp(3*Z)) - (2*S3^2.*Y.*(S_v))/exp(2*Z) ...
 + (S3^2.*Y.*(S_v))/(2*exp(Z)) + (13*S3.*Y.^2*(S_v))/(2*exp(3*Z)) - (4*S3.*Y.^2*(S_v))/exp(2*Z) + (3*S3.*Y.^2*(S_v))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S3.*Y.^2*(S_v))/2 ...
 + (5*S3^2.*Y.^2*(S_v))/exp(3*Z) - (2*S3^2.*Y.^2*(S_v))/exp(2*Z) + (S3^2.*Y.^2*(S_v))/(2*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S3^2.*Y.^2*(S_v))/2 - (3*S3.*Y.^3*(S_v))/exp(3*Z) ...
 + (4*S3.*Y.^3*(S_v))/exp(2*Z) - (S3.*Y.^3*(S_v))/exp(Z) - (3*S3^2.*Y.^3*(S_v))/(2*exp(3*Z)) + (2*S3^2.*Y.^3*(S_v))/exp(2*Z) - (S3^2.*Y.^3*(S_v))/(2*exp(Z)) ...
 + (3*S3*(S_v))/(exp(4*Z)*Z^3) - (4*S3*(S_v))/(exp(3*Z)*Z^3) + (S3*(S_v))/(exp(2*Z)*Z^3) + (S3*(S_v))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S3*(S_v))/Z^3 ...
 - (4*exp(-Z - 2.*Y.*Z)*S3*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S3*(S_v))/Z^3 + (8*exp(-2*Z - Y.*Z)*S3*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S3*(S_v))/Z^3 ...
 + (3*S3^2*(S_v))/(exp(4*Z)*Z^3) - (4*S3^2*(S_v))/(exp(3*Z)*Z^3) + (S3^2*(S_v))/(exp(2*Z)*Z^3) + (S3^2*(S_v))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S3^2*(S_v))/Z^3 ...
 - (4*exp(-Z - 2.*Y.*Z)*S3^2*(S_v))/Z^3 - (6*exp(-3*Z - Y.*Z)*S3^2*(S_v))/Z^3 + (8*exp(-2*Z - Y.*Z)*S3^2*(S_v))/Z^3 - (2*exp(-Z - Y.*Z)*S3^2*(S_v))/Z^3 ...
 + (11*S3*(S_v))/(exp(3*Z)*Z^2) - (8*S3*(S_v))/(exp(2*Z)*Z^2) + (2*S3*(S_v))/(exp(Z)*Z^2) - (S3*(S_v))/(exp(3.*Y.*Z)*Z^2) - (2*S3*(S_v))/(exp(Y.*Z)*Z^2) ...
 - (exp(-Z - 2.*Y.*Z)*S3*(S_v))/Z^2 - (9*exp(-2*Z - Y.*Z)*S3*(S_v))/Z^2 + (8*exp(-Z - Y.*Z)*S3*(S_v))/Z^2 + (8*S3^2*(S_v))/(exp(3*Z)*Z^2); ...
 - (4*S3^2*(S_v))/(exp(2*Z)*Z^2) + (S3^2*(S_v))/(exp(Z)*Z^2) - (S3^2*(S_v))/(exp(3.*Y.*Z)*Z^2) - (S3^2*(S_v))/(exp(Y.*Z)*Z^2) - (exp(-Z - 2.*Y.*Z)*S3^2*(S_v))/Z^2 ...
 - (6*exp(-2*Z - Y.*Z)*S3^2*(S_v))/Z^2 + (4*exp(-Z - Y.*Z)*S3^2*(S_v))/Z^2 - (6*S3.*Y.*(S_v))/(exp(3*Z)*Z^2) + (8*S3.*Y.*(S_v))/(exp(2*Z)*Z^2) ...
 - (2*S3.*Y.*(S_v))/(exp(Z)*Z^2) + (2*S3.*Y.*(S_v))/(exp(Y.*Z)*Z^2) + (6*exp(-2*Z - Y.*Z)*S3.*Y.*(S_v))/Z^2 - (8*exp(-Z - Y.*Z)*S3.*Y.*(S_v))/Z^2 ...
 - (3*S3^2.*Y.*(S_v))/(exp(3*Z)*Z^2) + (4*S3^2.*Y.*(S_v))/(exp(2*Z)*Z^2) - (S3^2.*Y.*(S_v))/(exp(Z)*Z^2) + (S3^2.*Y.*(S_v))/(exp(Y.*Z)*Z^2) ...
 + (3*exp(-2*Z - Y.*Z)*S3^2.*Y.*(S_v))/Z^2 - (4*exp(-Z - Y.*Z)*S3^2.*Y.*(S_v))/Z^2 + (S3*(S_v))/Z + (2*S3*(S_v))/(exp(3*Z)*Z) + (9*S3*(S_v))/(exp(2*Z)*Z) ...
 - (4*S3*(S_v))/(exp(Z)*Z) + (S3*(S_v))/(exp(2.*Y.*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S3*(S_v))/Z + (exp(-Z - Y.*Z)*S3*(S_v))/Z + (2*S3^2*(S_v))/(exp(3*Z)*Z) ...
 + (S3^2*(S_v))/(exp(2*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S3^2*(S_v))/Z - (exp(-Z - Y.*Z)*S3^2*(S_v))/Z - (2*S3.*Y.*(S_v))/Z - (13*S3.*Y.*(S_v))/(exp(2*Z)*Z) ...

$$\begin{aligned}
& + \frac{(8*S3.*Y.*(S_v))}{(\exp(Z)*Z)} - \frac{(S3.*Y.*(S_v))}{(\exp(2.*Y.*Z)*Z)} - \\
& (2*S3^2.*Y.*(S_v))/(\exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z)*S3^2.*Y.*(S_v))/Z + (S3.*Y.^2*(S_v))/Z ... \\
& + \frac{(3*S3.*Y.^2*(S_v))}{(\exp(4*Z)*Z)} - \frac{(4*S3.*Y.^2*(S_v))}{(\exp(3*Z)*Z)} + \\
& (4*S3.*Y.^2*(S_v))/(\exp(2*Z)*Z) - (4*S3.*Y.^2*(S_v))/(\exp(Z)*Z) ... \\
& - (3*\exp(-3*Z - Y.*Z)*S3.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S3.*Y.^2*(S_v))/Z - (\exp(-Z - \\
& Y.*Z)*S3.*Y.^2*(S_v))/Z + (3*S3^2.*Y.^2*(S_v))/(\exp(4*Z)*Z) ... \\
& - (4*S3^2.*Y.^2*(S_v))/(\exp(3*Z)*Z) + (S3^2.*Y.^2*(S_v))/(\exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z)*S3^2.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S3^2.*Y.^2*(S_v))/Z ... \\
& - (\exp(-Z - Y.*Z)*S3^2.*Y.^2*(S_v))/Z - (3*S3^2.*Z*(S_v))/(4*\exp(4*Z)) - (7*S3^2.*Z*(S_v))/(4*\exp(2*Z)) \\
& - (3*S3^2.*Z*(S_v))/(4*\exp(4*Z)) - (3*S3^2.*Z*(S_v))/(4*\exp(2*Z)) ... \\
& + (2*S3.*Y.*Z*(S_v))/\exp(2*Z) + (S3^2.*Y.*Z*(S_v))/\exp(2*Z) + (S3.*Y.^2*Z*(S_v))/\exp(3*Z) + \\
& (3*S3.*Y.^2*Z*(S_v))/(2*\exp(2*Z)) + (S3^2.*Y.^2*Z*(S_v))/\exp(3*Z) ... \\
& + \frac{(S3^2.*Y.^2*Z*(S_v))}{(2*\exp(2*Z))} - \frac{(2*S3.*Y.^3*Z*(S_v))}{\exp(2*Z)} - \\
& (S3^2.*Y.^3*Z*(S_v))/\exp(2*Z) + (3*S3.*Y.^4*Z*(S_v))/(4*\exp(4*Z)) - (S3.*Y.^4*Z*(S_v))/\exp(3*Z) \\
& ... \\
& + \frac{(S3.*Y.^4*Z*(S_v))}{(4*\exp(2*Z))} + \frac{(3*S3^2.*Y.^4*Z*(S_v))}{(4*\exp(4*Z))} - \\
& (S3^2.*Y.^4*Z*(S_v))/\exp(3*Z) + (S3^2.*Y.^4*Z*(S_v))/(4*\exp(2*Z)) + (S3^2.*Z^2*(S_v))/(2*\exp(3*Z)) \\
& ... \\
& + \frac{(S3^2.*Z^2*(S_v))}{(2*\exp(3*Z))} - \frac{(S3.*Y.^2*Z^2*(S_v))}{\exp(3*Z)} - \\
& (S3^2.*Y.^2*Z^2*(S_v))/\exp(3*Z) + (S3.*Y.^4*Z^2*(S_v))/(2*\exp(3*Z)) ... \\
& + \frac{(S3^2.*Y.^4*Z^2*(S_v))}{(2*\exp(3*Z))} + \frac{(9*S3^2*(S_v)^2)}{(16*\exp(6*Z))} - \\
& (23*S3^2*(S_v)^2)/(8*\exp(4*Z)) + (2*S3^2*(S_v)^2)/\exp(3*Z) + (S3^2*(S_v)^2)/(16*\exp(2*Z)) ... \\
& - (\exp(-2*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/2 - \exp(-3*Z - Y.*Z)*S3^2*(S_v)^2 - \\
& (2*S3^2.*Y.*(S_v)^2)/\exp(3*Z) - (S3^2.*Y.*(S_v)^2)/\exp(2*Z) + (9*S3^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z)) \\
& ... \\
& - \frac{(3*S3^2.*Y.^2*(S_v)^2)}{(2*\exp(5*Z))} + \frac{(11*S3^2.*Y.^2*(S_v)^2)}{(2*\exp(4*Z))} - \\
& (7*S3^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z)) + (15*S3^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z)) ... \\
& + (\exp(-2*Z - 2.*Y.*Z)*S3^2.*Y.^2*(S_v)^2)/2 + \exp(-3*Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2 - \\
& (3*S3^2.*Y.^3*(S_v)^2)/\exp(4*Z) + (4*S3^2.*Y.^3*(S_v)^2)/\exp(3*Z) ... \\
& - \frac{(S3^2.*Y.^3*(S_v)^2)}{\exp(2*Z)} + \frac{(9*S3^2.*Y.^4*(S_v)^2)}{(16*\exp(6*Z))} - \\
& (3*S3^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z)) + (11*S3^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z)) ... \\
& - \frac{(S3^2.*Y.^4*(S_v)^2)}{(2*\exp(3*Z))} + \frac{(S3^2.*Y.^4*(S_v)^2)}{(16*\exp(2*Z))} + \\
& (9*S3^2*(S_v)^2)/(4*\exp(6*Z)*Z^4) - (6*S3^2*(S_v)^2)/(\exp(5*Z)*Z^4) ... \\
& + \frac{(11*S3^2*(S_v)^2)}{(2*\exp(4*Z)*Z^4)} - \frac{(2*S3^2*(S_v)^2)}{(\exp(3*Z)*Z^4)} + \\
& (S3^2*(S_v)^2)/(4*\exp(2*Z)*Z^4) + (S3^2*(S_v)^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z)*S3^2*(S_v)^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S3^2*(S_v)^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S3^2*(S_v)^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S3^2*(S_v)^2)/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z)*S3^2*(S_v)^2)/Z^4 - (\exp(-Z - Y.*Z)*S3^2*(S_v)^2)/(2*Z^4) + \\
& (12*S3^2*(S_v)^2)/(\exp(5*Z)*Z^3) - (22*S3^2*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& + \frac{(27*S3^2*(S_v)^2)}{(2*\exp(3*Z)*Z^3)} - \frac{(4*S3^2*(S_v)^2)}{(\exp(2*Z)*Z^3)} + \\
& (S3^2*(S_v)^2)/(2*\exp(Z)*Z^3) - (S3^2*(S_v)^2)/(2*\exp(3.*Y.*Z)*Z^3) ... \\
& - (S3^2*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S3^2*(S_v)^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S3^2*(S_v)^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S3^2*(S_v)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S3^2*(S_v)^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S3^2*(S_v)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S3^2*(S_v)^2)/Z^3 - \\
& (9*S3^2.*Y.*(S_v)^2)/(2*\exp(5*Z)*Z^3) + (12*S3^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^3) ... \\
& - \frac{(11*S3^2.*Y.*(S_v)^2)}{(\exp(3*Z)*Z^3)} + \frac{(4*S3^2.*Y.*(S_v)^2)}{(\exp(2*Z)*Z^3)} - \\
& (S3^2.*Y.*(S_v)^2)/(2*\exp(Z)*Z^3) + (S3^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S3^2.*Y.*(S_v)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S3^2.*Y.*(S_v)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S3^2.*Y.*(S_v)^2)/Z^3 ... \\
& - \frac{(4*\exp(-Z - Y.*Z)*S3^2.*Y.*(S_v)^2)}{Z^3} + \frac{(S3^2*(S_v)^2)}{(4*Z^2)} + \\
& (9*S3^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - \frac{(3*S3^2*(S_v)^2)}{(\exp(5*Z)*Z^2)} + \\
& (19*S3^2*(S_v)^2)/(\exp(4*Z)*Z^2) ...
\end{aligned}$$

$$\begin{aligned}
& - (19*S3^2*(S_v)^2)/(exp(3*Z)*Z^2) + (35*S3^2*(S_v)^2)/(4*exp(2*Z)*Z^2) - \\
& (2*S3^2*(S_v)^2)/(exp(Z)*Z^2) + (S3^2*(S_v)^2)/(4*exp(4*Y.*Z)*Z^2) ... \\
& + (S3^2*(S_v)^2)/(2*exp(2.*Y.*Z)*Z^2) + (exp(-Z - 3.*Y.*Z)*S3^2*(S_v)^2)/Z^2 + (5*exp(-2*Z - \\
& 2.*Y.*Z)*S3^2*(S_v)^2)/Z^2 - (2*exp(-Z - 2.*Y.*Z)*S3^2*(S_v)^2)/Z^2 ... \\
& - (9*exp(-5*Z - Y.*Z)*S3^2*(S_v)^2)/(4*Z^2) + (3*exp(-4*Z - Y.*Z)*S3^2*(S_v)^2)/Z^2 + (5*exp(- \\
& 3*Z - Y.*Z)*S3^2*(S_v)^2)/Z^2 - (exp(-2*Z - Y.*Z)*S3^2*(S_v)^2)/Z^2 ... \\
& + (exp(-Z - Y.*Z)*S3^2*(S_v)^2)/(4*Z^2) - (S3^2.*Y.*(S_v)^2)/(2*Z^2) - \\
& (15*S3^2.*Y.*(S_v)^2)/(exp(4*Z)*Z^2) + (26*S3^2.*Y.*(S_v)^2)/(exp(3*Z)*Z^2) ... \\
& - (29*S3^2.*Y.*(S_v)^2)/(2*exp(2*Z)*Z^2) + (4*S3^2.*Y.*(S_v)^2)/(exp(Z)*Z^2) - \\
& (S3^2.*Y.*(S_v)^2)/(2*exp(2.*Y.*Z)*Z^2) - (3*exp(-2*Z - 2.*Y.*Z)*S3^2.*Y.*(S_v)^2)/(2*Z^2) ... \\
& + (2*exp(-Z - 2.*Y.*Z)*S3^2.*Y.*(S_v)^2)/Z^2 + (S3^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S3^2.*Y.^2*(S_v)^2)/(4*exp(6*Z)*Z^2) - (6*S3^2.*Y.^2*(S_v)^2)/(exp(5*Z)*Z^2) ... \\
& + (31*S3^2.*Y.^2*(S_v)^2)/(4*exp(4*Z)*Z^2) - (8*S3^2.*Y.^2*(S_v)^2)/(exp(3*Z)*Z^2) + \\
& (23*S3^2.*Y.^2*(S_v)^2)/(4*exp(2*Z)*Z^2) - (2*S3^2.*Y.^2*(S_v)^2)/(exp(Z)*Z^2) ... \\
& - (9*exp(-5*Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*exp(-4*Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2)/Z^2 \\
& - (11*exp(-3*Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2)/(2*Z^2) ... \\
& + (2*exp(-2*Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2)/Z^2 - (exp(-Z - Y.*Z)*S3^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S3^2*(S_v)^2)/(2*exp(5*Z)*Z) - (S3^2*(S_v)^2)/(exp(4*Z)*Z) ... \\
& + (25*S3^2*(S_v)^2)/(4*exp(3*Z)*Z) - (3*S3^2*(S_v)^2)/(exp(2*Z)*Z) + \\
& (3*S3^2*(S_v)^2)/(4*exp(Z)*Z) + (3*exp(-3*Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(4*Z) ... \\
& + (3*exp(-Z - 2.*Y.*Z)*S3^2*(S_v)^2)/(4*Z) + (3*exp(-4*Z - Y.*Z)*S3^2*(S_v)^2)/Z - (2*exp(-3*Z - \\
& Y.*Z)*S3^2*(S_v)^2)/Z + (2*exp(-2*Z - Y.*Z)*S3^2*(S_v)^2)/Z ... \\
& - (9*S3^2.*Y.*(S_v)^2)/(4*exp(5*Z)*Z) + (3*S3^2.*Y.*(S_v)^2)/(exp(4*Z)*Z) - \\
& (11*S3^2.*Y.*(S_v)^2)/(exp(3*Z)*Z) + (7*S3^2.*Y.*(S_v)^2)/(exp(2*Z)*Z) ... \\
& - (7*S3^2.*Y.*(S_v)^2)/(4*exp(Z)*Z) - (exp(-Z - 2.*Y.*Z)*S3^2.*Y.*(S_v)^2)/Z - (2*exp(-2*Z - \\
& Y.*Z)*S3^2.*Y.*(S_v)^2)/Z + (15*S3^2.*Y.^2*(S_v)^2)/(2*exp(5*Z)*Z) ... \\
& - (13*S3^2.*Y.^2*(S_v)^2)/(exp(4*Z)*Z) + (41*S3^2.*Y.^2*(S_v)^2)/(4*exp(3*Z)*Z) - \\
& (6*S3^2.*Y.^2*(S_v)^2)/(exp(2*Z)*Z) + (5*S3^2.*Y.^2*(S_v)^2)/(4*exp(Z)*Z) ... \\
& + (3*exp(-3*Z - 2.*Y.*Z)*S3^2.*Y.^2*(S_v)^2)/(4*Z) - (exp(-2*Z - 2.*Y.*Z)*S3^2.*Y.^2*(S_v)^2)/Z \\
& + (exp(-Z - 2.*Y.*Z)*S3^2.*Y.^2*(S_v)^2)/(4*Z) ... \\
& - (9*S3^2.*Y.^3*(S_v)^2)/(4*exp(5*Z)*Z) + (6*S3^2.*Y.^3*(S_v)^2)/(exp(4*Z)*Z) - \\
& (11*S3^2.*Y.^3*(S_v)^2)/(2*exp(3*Z)*Z) + (2*S3^2.*Y.^3*(S_v)^2)/(exp(2*Z)*Z) ... \\
& - (S3^2.*Y.^3*(S_v)^2)/(4*exp(Z)*Z) - (3*S3^2.*Z*(S_v)^2)/(4*exp(5*Z)) - \\
& (3*S3^2.*Z*(S_v)^2)/(4*exp(3*Z)) + (S3^2.*Y.*Z*(S_v)^2)/exp(3*Z) + \\
& (S3^2.*Y.^2*Z*(S_v)^2)/exp(4*Z) ... \\
& + (S3^2.*Y.^2*Z*(S_v)^2)/(2*exp(3*Z)) - (S3^2.*Y.^3*Z*(S_v)^2)/exp(3*Z) + \\
& (3*S3^2.*Y.^4*Z*(S_v)^2)/(4*exp(5*Z)) - (S3^2.*Y.^4*Z*(S_v)^2)/exp(4*Z) ... \\
& + (S3^2.*Y.^4*Z*(S_v)^2)/(4*exp(3*Z)) + (S3^2.*Z^2*(S_v)^2)/(4*exp(4*Z)) - \\
& (S3^2.*Y.^2*Z^2*(S_v)^2)/(2*exp(4*Z)) + (S3^2.*Y.^4*Z^2*(S_v)^2)/(4*exp(4*Z));
\end{aligned}$$

$$\begin{aligned}
Ns3 &= Nf + Nc + Ny3; \\
Phi3 &= Nf / [Nc + Ny3]; \\
Be3 &= 1 / [1 + Phi3]; \\
Gf3 &= Nf / Ns3; \\
Gh3 &= [Nc + Ny3] / Ns3; \\
Nh3 &= Nc + Ny3;
\end{aligned}$$

$$\begin{aligned}
S4 &= 4; \\
Ny4 &= 1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S4)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S4 - S4^2/exp(2*Z) + exp(-Z - \\
& Y.*Z)*S4^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z)*Y.^2 ... \\
& + (2*S4.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S4.*Y.^2 + (S4^2.*Y.^2)/exp(2*Z) - exp(-Z - \\
& Y.*Z)*S4^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ... \\
& - (2*exp(-Z - Y.*Z))/Z^2 + (2*S4)/(exp(2*Z)*Z^2) + (2*S4)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - \\
& Y.*Z)*S4)/Z^2 + S4^2/(exp(2*Z)*Z^2) + S4^2/(exp(2.*Y.*Z)*Z^2) ...
\end{aligned}$$

$$\begin{aligned}
& - (2*\exp(-Z - Y.*Z)*S4^2)/Z^2 + 2/(\exp(Z)*Z) - 2./(\exp(Y.*Z)*Z) + (2*S4)/(\exp(Z)*Z) - \\
& (2*S4)/(\exp(Y.*Z)*Z) - (2.*Y)/(\exp(Z)*Z) + (2.*Y)/(\exp(Y.*Z)*Z) ... \\
& - (2*S4.*Y)/(\exp(Z)*Z) + (2*S4.*Y)/(\exp(Y.*Z)*Z) - Z/\exp(Z) - (S4*Z)/\exp(Z) + (Y.*Z)/\exp(Z) + \\
& (S4.*Y.*Z)/\exp(Z) + (Y.^2*Z)/\exp(Z) + (S4.*Y.^2*Z)/\exp(Z) - (Y.^3*Z)/\exp(Z) ... \\
& - (S4.*Y.^3*Z)/\exp(Z) + Z^2/(4*\exp(2*Z)) + (S4*Z^2)/(2*\exp(2*Z)) + (S4^2*Z^2)/(4*\exp(2*Z)) - \\
& (Y.^2*Z^2)/(2*\exp(2*Z)) - (S4.*Y.^2*Z^2)/\exp(2*Z) ... \\
& - (S4^2.*Y.^2*Z^2)/(2*\exp(2*Z)) + (Y.^4*Z^2)/(4*\exp(2*Z)) + (S4.*Y.^4*Z^2)/(2*\exp(2*Z)) + \\
& (S4^2.*Y.^4*Z^2)/(4*\exp(2*Z)) - (7*S4*(S_v))/ (2*\exp(3*Z)) ... \\
& + (2*S4*(S_v))/\exp(2*Z) + (S4*(S_v))/\exp(Z) - (\exp(-Z - 2.*Y.*Z)*S4*(S_v))/2 - \\
& (5*S4^2*(S_v))/\exp(3*Z) + (2*S4^2*(S_v))/\exp(2*Z) - (S4^2*(S_v))/(2*\exp(Z)) ... \\
& - (\exp(-Z - 2.*Y.*Z)*S4^2*(S_v))/2 - (2*S4.*Y.*(S_v))/\exp(2*Z) - (3*S4.*Y.*(S_v))/\exp(Z) + \\
& (3*S4^2.*Y.*(S_v))/(2*\exp(3*Z)) - (2*S4^2.*Y.*(S_v))/\exp(2*Z) ... \\
& + (S4^2.*Y.*(S_v))/(2*\exp(Z)) + (13*S4.*Y.^2*(S_v))/(2*\exp(3*Z)) - (4*S4.*Y.^2*(S_v))/\exp(2*Z) + \\
& (3*S4.*Y.^2*(S_v))/\exp(Z) + (\exp(-Z - 2.*Y.*Z)*S4.*Y.^2*(S_v))/2 ... \\
& + (5*S4^2.*Y.^2*(S_v))/\exp(3*Z) - (2*S4^2.*Y.^2*(S_v))/\exp(2*Z) + (S4^2.*Y.^2*(S_v))/(2*\exp(Z)) \\
& + (\exp(-Z - 2.*Y.*Z)*S4^2.*Y.^2*(S_v))/2 - (3*S4.*Y.^3*(S_v))/\exp(3*Z) ... \\
& + (4*S4.*Y.^3*(S_v))/\exp(2*Z) - (S4.*Y.^3*(S_v))/\exp(Z) - (3*S4^2.*Y.^3*(S_v))/(2*\exp(3*Z)) + \\
& (2*S4^2.*Y.^3*(S_v))/\exp(2*Z) - (S4^2.*Y.^3*(S_v))/(2*\exp(Z)) ... \\
& + (3*S4*(S_v))/(\exp(4*Z)*Z^3) - (4*S4*(S_v))/(\exp(3*Z)*Z^3) + (S4*(S_v))/(\exp(2*Z)*Z^3) + \\
& (S4*(S_v))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S4*(S_v))/Z^3 ... \\
& - (4*\exp(-Z - 2.*Y.*Z)*S4*(S_v))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S4*(S_v))/Z^3 + (8*\exp(-2*Z - \\
& Y.*Z)*S4*(S_v))/Z^3 - (2*\exp(-Z - Y.*Z)*S4*(S_v))/Z^3 ... \\
& + (3*S4^2*(S_v))/(\exp(4*Z)*Z^3) - (4*S4^2*(S_v))/(\exp(3*Z)*Z^3) + (S4^2*(S_v))/(\exp(2*Z)*Z^3) + \\
& (S4^2*(S_v))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S4^2*(S_v))/Z^3 ... \\
& - (4*\exp(-Z - 2.*Y.*Z)*S4^2*(S_v))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S4^2*(S_v))/Z^3 + (8*\exp(-2*Z - \\
& Y.*Z)*S4^2*(S_v))/Z^3 - (2*\exp(-Z - Y.*Z)*S4^2*(S_v))/Z^3 ... \\
& + (11*S4*(S_v))/(\exp(3*Z)*Z^2) - (8*S4*(S_v))/(\exp(2*Z)*Z^2) + (2*S4*(S_v))/(\exp(Z)*Z^2) - \\
& (S4*(S_v))/(\exp(3.*Y.*Z)*Z^2) - (2*S4*(S_v))/(\exp(Y.*Z)*Z^2) ... \\
& - (\exp(-Z - 2.*Y.*Z)*S4*(S_v))/Z^2 - (9*\exp(-2*Z - Y.*Z)*S4*(S_v))/Z^2 + (8*\exp(-Z - \\
& Y.*Z)*S4*(S_v))/Z^2 + (8*S4^2*(S_v))/(\exp(3*Z)*Z^2); ... \\
& - (4*S4^2*(S_v))/(\exp(2*Z)*Z^2) + (S4^2*(S_v))/(\exp(Z)*Z^2) - (S4^2*(S_v))/(\exp(3.*Y.*Z)*Z^2) - \\
& (S4^2*(S_v))/(\exp(Y.*Z)*Z^2) - (\exp(-Z - 2.*Y.*Z)*S4^2*(S_v))/Z^2 ... \\
& - (6*\exp(-2*Z - Y.*Z)*S4^2*(S_v))/Z^2 + (4*\exp(-Z - Y.*Z)*S4^2*(S_v))/Z^2 - \\
& (6*S4.*Y.*(S_v))/(\exp(3*Z)*Z^2) + (8*S4.*Y.*(S_v))/(\exp(2*Z)*Z^2) ... \\
& - (2*S4.*Y.*(S_v))/(\exp(Z)*Z^2) + (2*S4.*Y.*(S_v))/(\exp(Y.*Z)*Z^2) + (6*\exp(-2*Z - \\
& Y.*Z)*S4.*Y.*(S_v))/Z^2 - (8*\exp(-Z - Y.*Z)*S4.*Y.*(S_v))/Z^2 ... \\
& - (3*S4^2.*Y.*(S_v))/(\exp(3*Z)*Z^2) + (4*S4^2.*Y.*(S_v))/(\exp(2*Z)*Z^2) - \\
& (S4^2.*Y.*(S_v))/(\exp(Z)*Z^2) + (S4^2.*Y.*(S_v))/(\exp(Y.*Z)*Z^2) ... \\
& + (3*\exp(-2*Z - Y.*Z)*S4^2.*Y.*(S_v))/Z^2 - (4*\exp(-Z - Y.*Z)*S4^2.*Y.*(S_v))/Z^2 + (S4*(S_v))/Z \\
& + (2*S4*(S_v))/(\exp(3*Z)*Z) + (9*S4*(S_v))/(\exp(2*Z)*Z) ... \\
& - (4*S4*(S_v))/(\exp(Z)*Z) + (S4*(S_v))/(\exp(2.*Y.*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S4*(S_v))/Z + \\
& (\exp(-Z - Y.*Z)*S4*(S_v))/Z + (2*S4^2*(S_v))/(\exp(3*Z)*Z) ... \\
& + (S4^2*(S_v))/(\exp(2*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S4^2*(S_v))/Z - (\exp(-Z - Y.*Z)*S4^2*(S_v))/Z - \\
& (2*S4.*Y.*(S_v))/Z - (13*S4.*Y.*(S_v))/(\exp(2*Z)*Z) ... \\
& + (8*S4.*Y.*(S_v))/(\exp(Z)*Z) - (S4.*Y.*(S_v))/(\exp(2.*Y.*Z)*Z) - \\
& (2*S4^2.*Y.*(S_v))/(\exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z)*S4^2.*Y.*(S_v))/Z + (S4.*Y.^2*(S_v))/Z ... \\
& + (3*S4.*Y.^2*(S_v))/(\exp(4*Z)*Z) - (4*S4.*Y.^2*(S_v))/(\exp(3*Z)*Z) + \\
& (4*S4.*Y.^2*(S_v))/(\exp(2*Z)*Z) - (4*S4.*Y.^2*(S_v))/(\exp(Z)*Z) ... \\
& - (3*\exp(-3*Z - Y.*Z)*S4.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S4.*Y.^2*(S_v))/Z - (\exp(-Z - \\
& Y.*Z)*S4.*Y.^2*(S_v))/Z + (3*S4^2.*Y.^2*(S_v))/(\exp(4*Z)*Z) ... \\
& - (4*S4^2.*Y.^2*(S_v))/(\exp(3*Z)*Z) + (S4^2.*Y.^2*(S_v))/(\exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z)*S4^2.*Y.^2*(S_v))/Z + (4*\exp(-2*Z - Y.*Z)*S4^2.*Y.^2*(S_v))/Z ... \\
& - (\exp(-Z - Y.*Z)*S4^2.*Y.^2*(S_v))/Z - (3*S4*Z*(S_v))/(4*\exp(4*Z)) - (7*S4*Z*(S_v))/(4*\exp(2*Z)) \\
& - (3*S4^2*Z*(S_v))/(4*\exp(4*Z)) - (3*S4^2*Z*(S_v))/(4*\exp(2*Z)) ... \\
& + (2*S4.*Y.*Z*(S_v))/\exp(2*Z) + (S4^2.*Y.*Z*(S_v))/\exp(2*Z) + (S4.*Y.^2*Z*(S_v))/\exp(3*Z) + \\
& (3*S4.*Y.^2*Z*(S_v))/(2*\exp(2*Z)) + (S4^2.*Y.^2*Z*(S_v))/\exp(3*Z) ...
\end{aligned}$$

$$\begin{aligned}
& + \frac{(S_4^2 \cdot Y \cdot Z^2 (S_v))}{(2 \exp(2Z))} - \frac{(2 S_4 \cdot Y \cdot Z^3 (S_v))}{\exp(2Z)} - \\
& (S_4^2 \cdot Y \cdot Z^3 (S_v)) / \exp(2Z) + (3 S_4 \cdot Y \cdot Z^4 (S_v)) / (4 \exp(4Z)) - (S_4 \cdot Y \cdot Z^4 (S_v)) / \exp(3Z) \\
& \dots \\
& + \frac{(S_4 \cdot Y \cdot Z^4 (S_v))}{(4 \exp(2Z))} + \frac{(3 S_4^2 \cdot Y \cdot Z^4 (S_v))}{(4 \exp(4Z))} - \\
& (S_4^2 \cdot Y \cdot Z^4 (S_v)) / \exp(3Z) + (S_4^2 \cdot Y \cdot Z^4 (S_v)) / (4 \exp(2Z)) + (S_4 \cdot Z^2 (S_v)) / (2 \exp(3Z)) \\
& \dots \\
& + \frac{(S_4^2 \cdot Z^2 (S_v))}{(2 \exp(3Z))} - \frac{(S_4 \cdot Y \cdot Z^2 (S_v))}{\exp(3Z)} - \\
& (S_4^2 \cdot Y \cdot Z^2 (S_v)) / \exp(3Z) + (S_4 \cdot Y \cdot Z^2 (S_v)) / (2 \exp(3Z)) \dots \\
& + \frac{(S_4^2 \cdot Y \cdot Z^2 (S_v))}{(2 \exp(3Z))} + \frac{(9 S_4^2 (S_v)^2)}{(16 \exp(6Z))} - \\
& (23 S_4^2 (S_v)^2) / (8 \exp(4Z)) + (2 S_4^2 (S_v)^2) / \exp(3Z) + (S_4^2 (S_v)^2) / (16 \exp(2Z)) \dots \\
& - (\exp(-2Z) - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2 / 2 - \exp(-3Z - Y \cdot Z) S_4^2 (S_v)^2 - \\
& (2 S_4^2 \cdot Y \cdot (S_v)^2) / \exp(3Z) - (S_4^2 \cdot Y \cdot (S_v)^2) / \exp(2Z) + (9 S_4^2 \cdot Y \cdot Z^2 (S_v)^2) / (8 \exp(6Z)) \\
& \dots \\
& - \frac{(3 S_4^2 \cdot Y \cdot Z^2 (S_v)^2)}{(2 \exp(5Z))} + \frac{(11 S_4^2 \cdot Y \cdot Z^2 (S_v)^2)}{(2 \exp(4Z))} - \\
& (7 S_4^2 \cdot Y \cdot Z^2 (S_v)^2) / (2 \exp(3Z)) + (15 S_4^2 \cdot Y \cdot Z^2 (S_v)^2) / (8 \exp(2Z)) \dots \\
& + (\exp(-2Z) - 2 \cdot Y \cdot Z) S_4^2 \cdot Y \cdot Z^2 (S_v)^2 / 2 + \exp(-3Z - Y \cdot Z) S_4^2 \cdot Y \cdot Z^2 (S_v)^2 - \\
& (3 S_4^2 \cdot Y \cdot Z^3 (S_v)^2) / \exp(4Z) + (4 S_4^2 \cdot Y \cdot Z^3 (S_v)^2) / \exp(3Z) \dots \\
& - \frac{(S_4^2 \cdot Y \cdot Z^3 (S_v)^2)}{\exp(2Z)} + \frac{(9 S_4^2 \cdot Y \cdot Z^4 (S_v)^2)}{(16 \exp(6Z))} - \\
& (3 S_4^2 \cdot Y \cdot Z^4 (S_v)^2) / (2 \exp(5Z)) + (11 S_4^2 \cdot Y \cdot Z^4 (S_v)^2) / (8 \exp(4Z)) \dots \\
& - \frac{(S_4^2 \cdot Y \cdot Z^4 (S_v)^2)}{(2 \exp(3Z))} + \frac{(S_4^2 \cdot Y \cdot Z^4 (S_v)^2)}{(16 \exp(2Z))} + \\
& (9 S_4^2 (S_v)^2) / (4 \exp(6Z) \cdot Z^4) - (6 S_4^2 (S_v)^2) / (\exp(5Z) \cdot Z^4) \dots \\
& + \frac{(11 S_4^2 (S_v)^2)}{(2 \exp(4Z) \cdot Z^4)} - \frac{(2 S_4^2 (S_v)^2)}{(\exp(3Z) \cdot Z^4)} + \\
& (S_4^2 (S_v)^2) / (4 \exp(2Z) \cdot Z^4) + (S_4^2 (S_v)^2) / (4 \exp(2 \cdot Y \cdot Z) \cdot Z^4) \dots \\
& + (9 \exp(-4Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / (4 Z^4) - (6 \exp(-3Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^4 + \\
& (11 \exp(-2Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^4) \dots \\
& - (2 \exp(-Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^4 - (9 \exp(-5Z - Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^4) + (12 \exp(-4Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^4 - \\
& (11 \exp(-3Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^4 \dots \\
& + (4 \exp(-2Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^4 - (\exp(-Z - Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^4) + \\
& (12 S_4^2 (S_v)^2) / (\exp(5Z) \cdot Z^3) - (22 S_4^2 (S_v)^2) / (\exp(4Z) \cdot Z^3) \dots \\
& + \frac{(27 S_4^2 (S_v)^2)}{(2 \exp(3Z) \cdot Z^3)} - \frac{(4 S_4^2 (S_v)^2)}{(\exp(2Z) \cdot Z^3)} + \\
& (S_4^2 (S_v)^2) / (2 \exp(Z) \cdot Z^3) - (S_4^2 (S_v)^2) / (2 \exp(3 \cdot Y \cdot Z) \cdot Z^3) \dots \\
& - (S_4^2 (S_v)^2) / (2 \exp(Y \cdot Z) \cdot Z^3) - (3 \exp(-2Z - 3 \cdot Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^3) + (2 \exp(-Z - 3 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^3 - \\
& (3 \exp(-3Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^3) \dots \\
& + (2 \exp(-2Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^3 - (\exp(-Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^3) - (9 \exp(-4Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^3 + \\
& (18 \exp(-3Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^3 \dots \\
& - (25 \exp(-2Z - Y \cdot Z) S_4^2 (S_v)^2) / (2 Z^3) + (4 \exp(-Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^3 - \\
& (9 S_4^2 \cdot Y \cdot (S_v)^2) / (2 \exp(5Z) \cdot Z^3) + (12 S_4^2 \cdot Y \cdot (S_v)^2) / (\exp(4Z) \cdot Z^3) \dots \\
& - \frac{(11 S_4^2 \cdot Y \cdot (S_v)^2)}{(\exp(3Z) \cdot Z^3)} + \frac{(4 S_4^2 \cdot Y \cdot (S_v)^2)}{(\exp(2Z) \cdot Z^3)} - \\
& (S_4^2 \cdot Y \cdot (S_v)^2) / (2 \exp(Z) \cdot Z^3) + (S_4^2 \cdot Y \cdot (S_v)^2) / (2 \exp(Y \cdot Z) \cdot Z^3) \dots \\
& + (9 \exp(-4Z - Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2) / (2 Z^3) - (12 \exp(-3Z - Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2) / Z^3 + \\
& (11 \exp(-2Z - Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2) / Z^3 \dots \\
& - \frac{(4 \exp(-Z - Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2)}{Z^3} + \frac{(S_4^2 (S_v)^2)}{(4 Z^2)} + \\
& (9 S_4^2 (S_v)^2) / (4 \exp(6Z) \cdot Z^2) - \frac{(3 S_4^2 (S_v)^2)}{(\exp(5Z) \cdot Z^2)} + \\
& (19 S_4^2 (S_v)^2) / (\exp(4Z) \cdot Z^2) \dots \\
& - \frac{(19 S_4^2 (S_v)^2)}{(\exp(3Z) \cdot Z^2)} + \frac{(35 S_4^2 (S_v)^2)}{(4 \exp(2Z) \cdot Z^2)} - \\
& (2 S_4^2 (S_v)^2) / (\exp(Z) \cdot Z^2) + (S_4^2 (S_v)^2) / (4 \exp(4 \cdot Y \cdot Z) \cdot Z^2) \dots \\
& + \frac{(S_4^2 (S_v)^2)}{(2 \exp(2 \cdot Y \cdot Z) \cdot Z^2)} + (\exp(-Z - 3 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^2 + (5 \exp(-2Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^2 - \\
& (2 \exp(-Z - 2 \cdot Y \cdot Z) S_4^2 (S_v)^2) / Z^2 \dots \\
& - (9 \exp(-5Z - Y \cdot Z) S_4^2 (S_v)^2) / (4 Z^2) + (3 \exp(-4Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^2 + (5 \exp(-3Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^2 - \\
& (\exp(-2Z - Y \cdot Z) S_4^2 (S_v)^2) / Z^2 \dots \\
& + \frac{(\exp(-Z - Y \cdot Z) S_4^2 (S_v)^2)}{(4 Z^2)} - \frac{(S_4^2 \cdot Y \cdot (S_v)^2)}{(2 Z^2)} - \\
& (15 S_4^2 \cdot Y \cdot (S_v)^2) / (\exp(4Z) \cdot Z^2) + (26 S_4^2 \cdot Y \cdot (S_v)^2) / (\exp(3Z) \cdot Z^2) \dots \\
& - \frac{(29 S_4^2 \cdot Y \cdot (S_v)^2)}{(2 \exp(2Z) \cdot Z^2)} + \frac{(4 S_4^2 \cdot Y \cdot (S_v)^2)}{(\exp(Z) \cdot Z^2)} - \\
& (S_4^2 \cdot Y \cdot (S_v)^2) / (2 \exp(2 \cdot Y \cdot Z) \cdot Z^2) - (3 \exp(-2Z - 2 \cdot Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2) / (2 Z^2) \dots \\
& + \frac{(2 \exp(-Z - 2 \cdot Y \cdot Z) S_4^2 \cdot Y \cdot (S_v)^2)}{Z^2} + \frac{(S_4^2 \cdot Y \cdot Z^2 (S_v)^2)}{(4 Z^2)} + \\
& (9 S_4^2 \cdot Y \cdot Z^2 (S_v)^2) / (4 \exp(6Z) \cdot Z^2) - (6 S_4^2 \cdot Y \cdot Z^2 (S_v)^2) / (\exp(5Z) \cdot Z^2) \dots
\end{aligned}$$

$$\begin{aligned}
& + (31*S4^2.*Y.^2*(S_v)^2)/(4*exp(4*Z)*Z^2) - (8*S4^2.*Y.^2*(S_v)^2)/(exp(3*Z)*Z^2) + \\
& (23*S4^2.*Y.^2*(S_v)^2)/(4*exp(2*Z)*Z^2) - (2*S4^2.*Y.^2*(S_v)^2)/(exp(Z)*Z^2) ... \\
& - (9*exp(-5*Z - Y.*Z)*S4^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*exp(-4*Z - Y.*Z)*S4^2.*Y.^2*(S_v)^2)/Z^2 \\
& - (11*exp(-3*Z - Y.*Z)*S4^2.*Y.^2*(S_v)^2)/(2*Z^2) ... \\
& + (2*exp(-2*Z - Y.*Z)*S4^2.*Y.^2*(S_v)^2)/Z^2 - (exp(-Z - Y.*Z)*S4^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S4^2*(S_v)^2)/(2*exp(5*Z)*Z) - (S4^2*(S_v)^2)/(exp(4*Z)*Z) ... \\
& + (25*S4^2*(S_v)^2)/(4*exp(3*Z)*Z) - (3*S4^2*(S_v)^2)/(exp(2*Z)*Z) + \\
& (3*S4^2*(S_v)^2)/(4*exp(Z)*Z) + (3*exp(-3*Z - 2.*Y.*Z)*S4^2*(S_v)^2)/(4*Z) ... \\
& + (3*exp(-Z - 2.*Y.*Z)*S4^2*(S_v)^2)/(4*Z) + (3*exp(-4*Z - Y.*Z)*S4^2*(S_v)^2)/Z - (2*exp(-3*Z - \\
& Y.*Z)*S4^2*(S_v)^2)/Z + (2*exp(-2*Z - Y.*Z)*S4^2*(S_v)^2)/Z ... \\
& - (9*S4^2.*Y.*(S_v)^2)/(4*exp(5*Z)*Z) + (3*S4^2.*Y.*(S_v)^2)/(exp(4*Z)*Z) - \\
& (11*S4^2.*Y.*(S_v)^2)/(exp(3*Z)*Z) + (7*S4^2.*Y.*(S_v)^2)/(exp(2*Z)*Z) ... \\
& - (7*S4^2.*Y.*(S_v)^2)/(4*exp(Z)*Z) - (exp(-Z - 2.*Y.*Z)*S4^2.*Y.*(S_v)^2)/Z - (2*exp(-2*Z - \\
& Y.*Z)*S4^2.*Y.*(S_v)^2)/Z + (15*S4^2.*Y.^2*(S_v)^2)/(2*exp(5*Z)*Z) ... \\
& - (13*S4^2.*Y.^2*(S_v)^2)/(exp(4*Z)*Z) + (41*S4^2.*Y.^2*(S_v)^2)/(4*exp(3*Z)*Z) - \\
& (6*S4^2.*Y.^2*(S_v)^2)/(exp(2*Z)*Z) + (5*S4^2.*Y.^2*(S_v)^2)/(4*exp(Z)*Z) ... \\
& + (3*exp(-3*Z - 2.*Y.*Z)*S4^2.*Y.^2*(S_v)^2)/(4*Z) - (exp(-2*Z - 2.*Y.*Z)*S4^2.*Y.^2*(S_v)^2)/Z \\
& + (exp(-Z - 2.*Y.*Z)*S4^2.*Y.^2*(S_v)^2)/(4*Z) ... \\
& - (9*S4^2.*Y.^3*(S_v)^2)/(4*exp(5*Z)*Z) + (6*S4^2.*Y.^3*(S_v)^2)/(exp(4*Z)*Z) - \\
& (11*S4^2.*Y.^3*(S_v)^2)/(2*exp(3*Z)*Z) + (2*S4^2.*Y.^3*(S_v)^2)/(exp(2*Z)*Z) ... \\
& - (S4^2.*Y.^3*(S_v)^2)/(4*exp(Z)*Z) - (3*S4^2.*Z*(S_v)^2)/(4*exp(5*Z)) - \\
& (3*S4^2.*Z*(S_v)^2)/(4*exp(3*Z)) + (S4^2.*Y.*Z*(S_v)^2)/exp(3*Z) + \\
& (S4^2.*Y.^2*Z*(S_v)^2)/exp(4*Z) ... \\
& + (S4^2.*Y.^2*Z*(S_v)^2)/(2*exp(3*Z)) - (S4^2.*Y.^3*Z*(S_v)^2)/exp(3*Z) + \\
& (3*S4^2.*Y.^4*Z*(S_v)^2)/(4*exp(5*Z)) - (S4^2.*Y.^4*Z*(S_v)^2)/exp(4*Z) ... \\
& + (S4^2.*Y.^4*Z*(S_v)^2)/(4*exp(3*Z)) + (S4^2.*Z^2*(S_v)^2)/(4*exp(4*Z)) - \\
& (S4^2.*Y.^2*Z^2*(S_v)^2)/(2*exp(4*Z)) + (S4^2.*Y.^4*Z^2*(S_v)^2)/(4*exp(4*Z));
\end{aligned}$$

$$\begin{aligned}
Ns4 &= Nf + Nc + Ny4; \\
Phi4 &= Nf. / [Nc + Ny4]; \\
Be4 &= 1. / [1 + Phi4]; \\
Gf4 &= Nf. / Ns4; \\
Gh4 &= [Nc + Ny4]. / Ns4; \\
Nh4 &= Nc + Ny4;
\end{aligned}$$

$$\begin{aligned}
S5 &= 5; \\
Ny5 &= 1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S5)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S5 - S5^2/exp(2*Z) + exp(-Z - \\
& Y.*Z)*S5^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z).*Y.^2 ... \\
& + (2*S5.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S5.*Y.^2 + (S5^2.*Y.^2)/exp(2*Z) - exp(-Z - \\
& Y.*Z)*S5^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ... \\
& - (2*exp(-Z - Y.*Z))/Z^2 + (2*S5)/(exp(2*Z)*Z^2) + (2*S5)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - \\
& Y.*Z)*S5)/Z^2 + S5^2/(exp(2*Z)*Z^2) + S5^2/(exp(2.*Y.*Z)*Z^2) ... \\
& - (2*exp(-Z - Y.*Z)*S5^2)/Z^2 + 2/(exp(Z)*Z) - 2/(exp(Y.*Z)*Z) + (2*S5)/(exp(Z)*Z) - \\
& (2*S5)/(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ... \\
& - (2*S5.*Y)/(exp(Z)*Z) + (2*S5.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S5*Z)/exp(Z) + (Y.*Z)/exp(Z) + \\
& (S5.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S5.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ... \\
& - (S5.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S5*Z^2)/(2*exp(2*Z)) + (S5^2*Z^2)/(4*exp(2*Z)) - \\
& (Y.^2*Z^2)/(2*exp(2*Z)) - (S5.*Y.^2*Z^2)/exp(2*Z) ... \\
& - (S5^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S5.*Y.^4*Z^2)/(2*exp(2*Z)) + \\
& (S5^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S5*(S_v))/(2*exp(3*Z)) ... \\
& + (2*S5*(S_v))/exp(2*Z) + (S5*(S_v))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S5*(S_v))/2 - \\
& (5*S5^2*(S_v))/exp(3*Z) + (2*S5^2*(S_v))/exp(2*Z) - (S5^2*(S_v))/(2*exp(Z)) ... \\
& - (exp(-Z - 2.*Y.*Z)*S5^2*(S_v))/2 - (2*S5.*Y.*(S_v))/exp(2*Z) - (3*S5.*Y.*(S_v))/exp(Z) + \\
& (3*S5^2.*Y.*(S_v))/(2*exp(3*Z)) - (2*S5^2.*Y.*(S_v))/exp(2*Z) ...
\end{aligned}$$

$$\begin{aligned}
& + (S5^2 * Y * (S_v)) / (2 * \exp(Z)) + (13 * S5 * Y.^2 * (S_v)) / (2 * \exp(3 * Z)) - (4 * S5 * Y.^2 * (S_v)) / \exp(2 * Z) + \\
& (3 * S5 * Y.^2 * (S_v)) / \exp(Z) + (\exp(-Z - 2 * Y * Z) * S5 * Y.^2 * (S_v)) / 2 \dots \\
& + (5 * S5^2 * Y.^2 * (S_v)) / \exp(3 * Z) - (2 * S5^2 * Y.^2 * (S_v)) / \exp(2 * Z) + (S5^2 * Y.^2 * (S_v)) / (2 * \exp(Z)) \\
& + (\exp(-Z - 2 * Y * Z) * S5^2 * Y.^2 * (S_v)) / 2 - (3 * S5 * Y.^3 * (S_v)) / \exp(3 * Z) \dots \\
& + (4 * S5 * Y.^3 * (S_v)) / \exp(2 * Z) - (S5 * Y.^3 * (S_v)) / \exp(Z) - (3 * S5^2 * Y.^3 * (S_v)) / (2 * \exp(3 * Z)) + \\
& (2 * S5^2 * Y.^3 * (S_v)) / \exp(2 * Z) - (S5^2 * Y.^3 * (S_v)) / (2 * \exp(Z)) \dots \\
& + (3 * S5 * (S_v)) / (\exp(4 * Z) * Z^3) - (4 * S5 * (S_v)) / (\exp(3 * Z) * Z^3) + (S5 * (S_v)) / (\exp(2 * Z) * Z^3) + \\
& (S5 * (S_v)) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S5 * (S_v)) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S5 * (S_v)) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S5 * (S_v)) / Z^3 + (8 * \exp(-2 * Z - \\
& Y * Z) * S5 * (S_v)) / Z^3 - (2 * \exp(-Z - Y * Z) * S5 * (S_v)) / Z^3 \dots \\
& + (3 * S5^2 * (S_v)) / (\exp(4 * Z) * Z^3) - (4 * S5^2 * (S_v)) / (\exp(3 * Z) * Z^3) + (S5^2 * (S_v)) / (\exp(2 * Z) * Z^3) + \\
& (S5^2 * (S_v)) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S5^2 * (S_v)) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S5^2 * (S_v)) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S5^2 * (S_v)) / Z^3 + (8 * \exp(-2 * Z - \\
& Y * Z) * S5^2 * (S_v)) / Z^3 - (2 * \exp(-Z - Y * Z) * S5^2 * (S_v)) / Z^3 \dots \\
& + (11 * S5 * (S_v)) / (\exp(3 * Z) * Z^2) - (8 * S5 * (S_v)) / (\exp(2 * Z) * Z^2) + (2 * S5 * (S_v)) / (\exp(Z) * Z^2) - \\
& (S5 * (S_v)) / (\exp(3 * Y * Z) * Z^2) - (2 * S5 * (S_v)) / (\exp(Y * Z) * Z^2) \dots \\
& - (\exp(-Z - 2 * Y * Z) * S5 * (S_v)) / Z^2 - (9 * \exp(-2 * Z - Y * Z) * S5 * (S_v)) / Z^2 + (8 * \exp(-Z - \\
& Y * Z) * S5 * (S_v)) / Z^2 + (8 * S5^2 * (S_v)) / (\exp(3 * Z) * Z^2); \dots \\
& - (4 * S5^2 * (S_v)) / (\exp(2 * Z) * Z^2) + (S5^2 * (S_v)) / (\exp(Z) * Z^2) - (S5^2 * (S_v)) / (\exp(3 * Y * Z) * Z^2) - \\
& (S5^2 * (S_v)) / (\exp(Y * Z) * Z^2) - (\exp(-Z - 2 * Y * Z) * S5^2 * (S_v)) / Z^2 \dots \\
& - (6 * \exp(-2 * Z - Y * Z) * S5^2 * (S_v)) / Z^2 + (4 * \exp(-Z - Y * Z) * S5^2 * (S_v)) / Z^2 - \\
& (6 * S5 * Y * (S_v)) / (\exp(3 * Z) * Z^2) + (8 * S5 * Y * (S_v)) / (\exp(2 * Z) * Z^2) \dots \\
& - (2 * S5 * Y * (S_v)) / (\exp(Z) * Z^2) + (2 * S5 * Y * (S_v)) / (\exp(Y * Z) * Z^2) + (6 * \exp(-2 * Z - \\
& Y * Z) * S5 * Y * (S_v)) / Z^2 - (8 * \exp(-Z - Y * Z) * S5 * Y * (S_v)) / Z^2 \dots \\
& - (3 * S5^2 * Y * (S_v)) / (\exp(3 * Z) * Z^2) + (4 * S5^2 * Y * (S_v)) / (\exp(2 * Z) * Z^2) - \\
& (S5^2 * Y * (S_v)) / (\exp(Z) * Z^2) + (S5^2 * Y * (S_v)) / (\exp(Y * Z) * Z^2) \dots \\
& + (3 * \exp(-2 * Z - Y * Z) * S5^2 * Y * (S_v)) / Z^2 - (4 * \exp(-Z - Y * Z) * S5^2 * Y * (S_v)) / Z^2 + (S5 * (S_v)) / Z \\
& + (2 * S5 * (S_v)) / (\exp(3 * Z) * Z) + (9 * S5 * (S_v)) / (\exp(2 * Z) * Z) \dots \\
& - (4 * S5 * (S_v)) / (\exp(Z) * Z) + (S5 * (S_v)) / (\exp(2 * Y * Z) * Z) - (2 * \exp(-2 * Z - Y * Z) * S5 * (S_v)) / Z + \\
& (\exp(-Z - Y * Z) * S5 * (S_v)) / Z + (2 * S5^2 * (S_v)) / (\exp(3 * Z) * Z) \dots \\
& + (S5^2 * (S_v)) / (\exp(2 * Z) * Z) - (2 * \exp(-2 * Z - Y * Z) * S5^2 * (S_v)) / Z - (\exp(-Z - Y * Z) * S5^2 * (S_v)) / Z - \\
& (2 * S5 * Y * (S_v)) / Z - (13 * S5 * Y * (S_v)) / (\exp(2 * Z) * Z) \dots \\
& + (8 * S5 * Y * (S_v)) / (\exp(Z) * Z) - (S5 * Y * (S_v)) / (\exp(2 * Y * Z) * Z) - \\
& (2 * S5^2 * Y * (S_v)) / (\exp(2 * Z) * Z) + (2 * \exp(-Z - Y * Z) * S5^2 * Y * (S_v)) / Z + (S5 * Y.^2 * (S_v)) / Z \dots \\
& + (3 * S5 * Y.^2 * (S_v)) / (\exp(4 * Z) * Z) - (4 * S5 * Y.^2 * (S_v)) / (\exp(3 * Z) * Z) + \\
& (4 * S5 * Y.^2 * (S_v)) / (\exp(2 * Z) * Z) - (4 * S5 * Y.^2 * (S_v)) / (\exp(Z) * Z) \dots \\
& - (3 * \exp(-3 * Z - Y * Z) * S5 * Y.^2 * (S_v)) / Z + (4 * \exp(-2 * Z - Y * Z) * S5 * Y.^2 * (S_v)) / Z - (\exp(-Z - \\
& Y * Z) * S5 * Y.^2 * (S_v)) / Z + (3 * S5^2 * Y.^2 * (S_v)) / (\exp(4 * Z) * Z) \dots \\
& - (4 * S5^2 * Y.^2 * (S_v)) / (\exp(3 * Z) * Z) + (S5^2 * Y.^2 * (S_v)) / (\exp(2 * Z) * Z) - (3 * \exp(-3 * Z - \\
& Y * Z) * S5^2 * Y.^2 * (S_v)) / Z + (4 * \exp(-2 * Z - Y * Z) * S5^2 * Y.^2 * (S_v)) / Z \dots \\
& - (\exp(-Z - Y * Z) * S5^2 * Y.^2 * (S_v)) / Z - (3 * S5 * Z * (S_v)) / (4 * \exp(4 * Z)) - (7 * S5 * Z * (S_v)) / (4 * \exp(2 * Z)) \\
& - (3 * S5^2 * Z * (S_v)) / (4 * \exp(4 * Z)) - (3 * S5^2 * Z * (S_v)) / (4 * \exp(2 * Z)) \dots \\
& + (2 * S5 * Y * Z * (S_v)) / \exp(2 * Z) + (S5^2 * Y * Z * (S_v)) / \exp(2 * Z) + (S5 * Y.^2 * Z * (S_v)) / \exp(3 * Z) + \\
& (3 * S5 * Y.^2 * Z * (S_v)) / (2 * \exp(2 * Z)) + (S5^2 * Y.^2 * Z * (S_v)) / \exp(3 * Z) \dots \\
& + (S5^2 * Y.^2 * Z * (S_v)) / (2 * \exp(2 * Z)) - (2 * S5 * Y.^3 * Z * (S_v)) / \exp(2 * Z) - \\
& (S5^2 * Y.^3 * Z * (S_v)) / \exp(2 * Z) + (3 * S5 * Y.^4 * Z * (S_v)) / (4 * \exp(4 * Z)) - (S5 * Y.^4 * Z * (S_v)) / \exp(3 * Z) \\
& \dots \\
& + (S5 * Y.^4 * Z * (S_v)) / (4 * \exp(2 * Z)) + (3 * S5^2 * Y.^4 * Z * (S_v)) / (4 * \exp(4 * Z)) - \\
& (S5^2 * Y.^4 * Z * (S_v)) / \exp(3 * Z) + (S5^2 * Y.^4 * Z * (S_v)) / (4 * \exp(2 * Z)) + (S5 * Z^2 * (S_v)) / (2 * \exp(3 * Z)) \\
& \dots \\
& + (S5^2 * Z^2 * (S_v)) / (2 * \exp(3 * Z)) - (S5 * Y.^2 * Z^2 * (S_v)) / \exp(3 * Z) - \\
& (S5^2 * Y.^2 * Z^2 * (S_v)) / \exp(3 * Z) + (S5 * Y.^4 * Z^2 * (S_v)) / (2 * \exp(3 * Z)) \dots \\
& + (S5^2 * Y.^4 * Z^2 * (S_v)) / (2 * \exp(3 * Z)) + (9 * S5^2 * (S_v)^2) / (16 * \exp(6 * Z)) - \\
& (23 * S5^2 * (S_v)^2) / (8 * \exp(4 * Z)) + (2 * S5^2 * (S_v)^2) / \exp(3 * Z) + (S5^2 * (S_v)^2) / (16 * \exp(2 * Z)) \dots
\end{aligned}$$

$$\begin{aligned}
& - (\exp(-2*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/2 - \exp(-3*Z - Y.*Z)*S5^2*(S_v)^2 - \\
& (2*S5^2.*Y.*(S_v)^2)/\exp(3*Z) - (S5^2.*Y.*(S_v)^2)/\exp(2*Z) + (9*S5^2.*Y.^2*(S_v)^2)/(8*\exp(6*Z)) \\
& \dots \\
& - (3*S5^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)) + (11*S5^2.*Y.^2*(S_v)^2)/(2*\exp(4*Z)) - \\
& (7*S5^2.*Y.^2*(S_v)^2)/(2*\exp(3*Z)) + (15*S5^2.*Y.^2*(S_v)^2)/(8*\exp(2*Z)) \dots \\
& + (\exp(-2*Z - 2.*Y.*Z)*S5^2.*Y.^2*(S_v)^2)/2 + \exp(-3*Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2 - \\
& (3*S5^2.*Y.^3*(S_v)^2)/\exp(4*Z) + (4*S5^2.*Y.^3*(S_v)^2)/\exp(3*Z) \dots \\
& - (S5^2.*Y.^3*(S_v)^2)/\exp(2*Z) + (9*S5^2.*Y.^4*(S_v)^2)/(16*\exp(6*Z)) - \\
& (3*S5^2.*Y.^4*(S_v)^2)/(2*\exp(5*Z)) + (11*S5^2.*Y.^4*(S_v)^2)/(8*\exp(4*Z)) \dots \\
& - (S5^2.*Y.^4*(S_v)^2)/(2*\exp(3*Z)) + (S5^2.*Y.^4*(S_v)^2)/(16*\exp(2*Z)) + \\
& (9*S5^2*(S_v)^2)/(4*\exp(6*Z)*Z^4) - (6*S5^2*(S_v)^2)/(\exp(5*Z)*Z^4) \dots \\
& + (11*S5^2*(S_v)^2)/(2*\exp(4*Z)*Z^4) - (2*S5^2*(S_v)^2)/(\exp(3*Z)*Z^4) + \\
& (S5^2*(S_v)^2)/(4*\exp(2*Z)*Z^4) + (S5^2*(S_v)^2)/(\exp(2.*Y.*Z)*Z^4) \dots \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(2*Z^4) \dots \\
& - (2*\exp(-Z - 2.*Y.*Z)*S5^2*(S_v)^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S5^2*(S_v)^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S5^2*(S_v)^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S5^2*(S_v)^2)/Z^4 \dots \\
& + (4*\exp(-2*Z - Y.*Z)*S5^2*(S_v)^2)/Z^4 - (\exp(-Z - Y.*Z)*S5^2*(S_v)^2)/(2*Z^4) + \\
& (12*S5^2*(S_v)^2)/(\exp(5*Z)*Z^3) - (22*S5^2*(S_v)^2)/(\exp(4*Z)*Z^3) \dots \\
& + (27*S5^2*(S_v)^2)/(2*\exp(3*Z)*Z^3) - (4*S5^2*(S_v)^2)/(\exp(2*Z)*Z^3) + \\
& (S5^2*(S_v)^2)/(2*\exp(Z)*Z^3) - (S5^2*(S_v)^2)/(2*\exp(3.*Y.*Z)*Z^3) \dots \\
& - (S5^2*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S5^2*(S_v)^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S5^2*(S_v)^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(2*Z^3) \dots \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S5^2*(S_v)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S5^2*(S_v)^2)/Z^3 \dots \\
& - (25*\exp(-2*Z - Y.*Z)*S5^2*(S_v)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S5^2*(S_v)^2)/Z^3 - \\
& (9*S5^2.*Y.*(S_v)^2)/(2*\exp(5*Z)*Z^3) + (12*S5^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^3) \dots \\
& - (11*S5^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^3) + (4*S5^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z^3) - \\
& (S5^2.*Y.*(S_v)^2)/(2*\exp(Z)*Z^3) + (S5^2.*Y.*(S_v)^2)/(2*\exp(Y.*Z)*Z^3) \dots \\
& + (9*\exp(-4*Z - Y.*Z)*S5^2.*Y.*(S_v)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S5^2.*Y.*(S_v)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S5^2.*Y.*(S_v)^2)/Z^3 \dots \\
& - (4*\exp(-Z - Y.*Z)*S5^2.*Y.*(S_v)^2)/Z^3 + (S5^2*(S_v)^2)/(4*Z^2) + \\
& (9*S5^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (3*S5^2*(S_v)^2)/(\exp(5*Z)*Z^2) + \\
& (19*S5^2*(S_v)^2)/(\exp(4*Z)*Z^2) \dots \\
& - (19*S5^2*(S_v)^2)/(\exp(3*Z)*Z^2) + (35*S5^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S5^2*(S_v)^2)/(\exp(Z)*Z^2) + (S5^2*(S_v)^2)/(4*\exp(4.*Y.*Z)*Z^2) \dots \\
& + (S5^2*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S5^2*(S_v)^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S5^2*(S_v)^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S5^2*(S_v)^2)/Z^2 \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S5^2*(S_v)^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S5^2*(S_v)^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S5^2*(S_v)^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S5^2*(S_v)^2)/Z^2 \dots \\
& + (\exp(-Z - Y.*Z)*S5^2*(S_v)^2)/(4*Z^2) - (S5^2.*Y.*(S_v)^2)/(2*Z^2) - \\
& (15*S5^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z^2) + (26*S5^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z^2) \dots \\
& - (29*S5^2.*Y.*(S_v)^2)/(2*\exp(2*Z)*Z^2) + (4*S5^2.*Y.*(S_v)^2)/(\exp(Z)*Z^2) - \\
& (S5^2.*Y.*(S_v)^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S5^2.*Y.*(S_v)^2)/(2*Z^2) \dots \\
& + (2*\exp(-Z - 2.*Y.*Z)*S5^2.*Y.*(S_v)^2)/Z^2 + (S5^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S5^2.*Y.^2*(S_v)^2)/(4*\exp(6*Z)*Z^2) - (6*S5^2.*Y.^2*(S_v)^2)/(\exp(5*Z)*Z^2) \dots \\
& + (31*S5^2.*Y.^2*(S_v)^2)/(4*\exp(4*Z)*Z^2) - (8*S5^2.*Y.^2*(S_v)^2)/(\exp(3*Z)*Z^2) + \\
& (23*S5^2.*Y.^2*(S_v)^2)/(4*\exp(2*Z)*Z^2) - (2*S5^2.*Y.^2*(S_v)^2)/(\exp(Z)*Z^2) \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2)/(2*Z^2) \dots \\
& + (2*\exp(-2*Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2)/Z^2 - (\exp(-Z - Y.*Z)*S5^2.*Y.^2*(S_v)^2)/(4*Z^2) + \\
& (9*S5^2*(S_v)^2)/(2*\exp(5*Z)*Z) - (S5^2*(S_v)^2)/(\exp(4*Z)*Z) \dots \\
& + (25*S5^2*(S_v)^2)/(4*\exp(3*Z)*Z) - (3*S5^2*(S_v)^2)/(\exp(2*Z)*Z) + \\
& (3*S5^2*(S_v)^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(4*Z) \dots \\
& + (3*\exp(-Z - 2.*Y.*Z)*S5^2*(S_v)^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S5^2*(S_v)^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S5^2*(S_v)^2)/Z + (2*\exp(-2*Z - Y.*Z)*S5^2*(S_v)^2)/Z \dots
\end{aligned}$$

$$\begin{aligned}
& - \frac{(9*S5^2.*Y.*(S_v)^2)/(4*\exp(5*Z)*Z)}{(11*S5^2.*Y.*(S_v)^2)/(\exp(3*Z)*Z) + (7*S5^2.*Y.*(S_v)^2)/(\exp(2*Z)*Z) \dots} + \frac{(3*S5^2.*Y.*(S_v)^2)/(\exp(4*Z)*Z)}{(7*S5^2.*Y.*(S_v)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S5^2.*Y.*(S_v)^2)/Z - (2*\exp(-2*Z - Y.*Z)*S5^2.*Y.*(S_v)^2)/Z + (15*S5^2.*Y.^2*(S_v)^2)/(2*\exp(5*Z)*Z) \dots} - \\
& - \frac{(13*S5^2.*Y.^2*(S_v)^2)/(\exp(4*Z)*Z)}{(6*S5^2.*Y.^2*(S_v)^2)/(\exp(2*Z)*Z) + (5*S5^2.*Y.^2*(S_v)^2)/(4*\exp(Z)*Z) \dots} + \frac{(41*S5^2.*Y.^2*(S_v)^2)/(4*\exp(3*Z)*Z)}{(3*\exp(-3*Z - 2.*Y.*Z)*S5^2.*Y.^2*(S_v)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S5^2.*Y.^2*(S_v)^2)/Z + (\exp(-Z - 2.*Y.*Z)*S5^2.*Y.^2*(S_v)^2)/(4*Z) \dots} - \\
& - \frac{(9*S5^2.*Y.^3*(S_v)^2)/(4*\exp(5*Z)*Z)}{(11*S5^2.*Y.^3*(S_v)^2)/(2*\exp(3*Z)*Z) + (2*S5^2.*Y.^3*(S_v)^2)/(\exp(2*Z)*Z) \dots} + \frac{(6*S5^2.*Y.^3*(S_v)^2)/(\exp(4*Z)*Z)}{(S5^2.*Y.^3*(S_v)^2)/(4*\exp(Z)*Z) - (3*S5^2.*Z*(S_v)^2)/(4*\exp(5*Z))} - \\
& (3*S5^2.*Z*(S_v)^2)/(4*\exp(3*Z)) + \frac{(S5^2.*Y.*Z*(S_v)^2)/\exp(3*Z)}{(S5^2.*Y.^2*Z*(S_v)^2)/\exp(4*Z) \dots} + \\
& + \frac{(S5^2.*Y.^2*Z*(S_v)^2)/(2*\exp(3*Z))}{(3*S5^2.*Y.^4*Z*(S_v)^2)/(4*\exp(5*Z)) - (S5^2.*Y.^4*Z*(S_v)^2)/\exp(4*Z) \dots} - \frac{(S5^2.*Y.^3*Z*(S_v)^2)/\exp(3*Z)}{(S5^2.*Y.^4*Z*(S_v)^2)/(4*\exp(3*Z)) + (S5^2.*Z^2*(S_v)^2)/(4*\exp(4*Z))} + \\
& (S5^2.*Y.^2*Z^2*(S_v)^2)/(2*\exp(4*Z)) + (S5^2.*Y.^4*Z^2*(S_v)^2)/(4*\exp(4*Z));
\end{aligned}$$

```

Ns5=Nf+Nc+Ny5;
Phi5=Nf./[Nc+Ny5];
Be5=1./[1+Phi5];
Gf5=Nf./Ns5;
Gh5=[Nc+Ny5]./Ns5;
Nh5=Nc+Ny5;

```

```

plot(Y,Ns1,'b',Y,Ns2,'g',Y,Ns3,'r',Y,Ns4,'k',Y,Ns5,'m')

```

```

% plot(Y,Be1,'b',Y,Be2,'g',Y,Be3,'r',Y,Be4,'k',Y,Be5,'m')

```

```

% plot(Y,Phi1,'b',Y,Phi2,'g',Y,Phi3,'r',Y,Phi4,'k',Y,Phi5,'m')

```

```

% plot(Y,Gf1,'b',Y,Gf2,'g',Y,Gf3,'r',Y,Gf4,'k',Y,Gf5,'m')

```

```

% plot(Y,Gh1,'b',Y,Gh2,'g',Y,Gh3,'r',Y,Gh4,'k',Y,Gh5,'m')

```

```

% plot(Y,Nf)

```

```

% plot(Y,Nh1,'b',Y,Nh2,'g',Y,Nh3,'r',Y,Nh4,'k',Y,Nh5,'m')

```

```

% plot(Nh1,Nf1,'b',Nh2,Nf2,'g',Nh3,Nf3,'r',Nh4,Nf4,'k',Nh5,Nf5,'m')

```

PLOTTOOLS ON

1.5. Distribution of $N_s, Be, \Phi, G_F, G_H, N_F$ and N_H versus Y for a range of S_v and set of S, Z, Br & Pe

S=1; Z=1; Br=1; Pe=2.5;
% S=1.5; Z=3.5; Br=0.5; Pe=5.5;

% % % % Z=6; S=8; Br=0.6; Pe=7;
% % % % Z=7.5; S=15; Br=0.6; Pe=2.5;
% % % % Z=5; S=0.75; Br=1; Pe=2;
% % % % Z=18; S=25; Br=0.9; Pe=5;

q=1.86;
s=1;
Dh=250*10^-6;
Y=0:0.005:1;

Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Nf=Br*[(Z^2).exp(-2.*Y.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-Y.*Z)];

S_v1=1;
Ny1=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S - S^2/exp(2*Z) + exp(-Z - Y.*Z)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z).*Y.^2 ...
+ (2*S.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z))/Z^2 + (2*S)/(exp(2*Z)*Z^2) + (2*S)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S)/Z^2 + S^2/(exp(2*Z)*Z^2) + S^2/(exp(2.*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(exp(Z)*Z) - 2/(exp(Y.*Z)*Z) + (2*S)/(exp(Z)*Z) - (2*S)/(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...
- (2*S.*Y)/(exp(Z)*Z) + (2*S.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ...
- (S.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S*Z^2)/(2*exp(2*Z)) + (S^2*Z^2)/(4*exp(2*Z)) - (Y.^2*Z^2)/(2*exp(2*Z)) - (S.*Y.^2*Z^2)/exp(2*Z) ...
- (S^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S.*Y.^4*Z^2)/(2*exp(2*Z)) + (S^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S*(S_v1))/(2*exp(3*Z)) ...
+ (2*S*(S_v1))/exp(2*Z) + (S*(S_v1))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S*(S_v1))/2 - (5*S^2*(S_v1))/exp(3*Z) + (2*S^2*(S_v1))/exp(2*Z) - (S^2*(S_v1))/(2*exp(Z)) ...
- (exp(-Z - 2.*Y.*Z)*S^2*(S_v1))/2 - (2*S.*Y.*(S_v1))/exp(2*Z) - (3*S.*Y.*(S_v1))/exp(Z) + (3*S^2.*Y.*(S_v1))/(2*exp(3*Z)) - (2*S^2.*Y.*(S_v1))/exp(2*Z) ...
+ (S^2.*Y.*(S_v1))/(2*exp(Z)) + (13*S.*Y.^2*(S_v1))/(2*exp(3*Z)) - (4*S.*Y.^2*(S_v1))/exp(2*Z) + (3*S.*Y.^2*(S_v1))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S.*Y.^2*(S_v1))/2 ...
+ (5*S^2.*Y.^2*(S_v1))/exp(3*Z) - (2*S^2.*Y.^2*(S_v1))/exp(2*Z) + (S^2.*Y.^2*(S_v1))/(2*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v1))/2 - (3*S.*Y.^3*(S_v1))/exp(3*Z) ...
+ (4*S.*Y.^3*(S_v1))/exp(2*Z) - (S.*Y.^3*(S_v1))/exp(Z) - (3*S^2.*Y.^3*(S_v1))/(2*exp(3*Z)) + (2*S^2.*Y.^3*(S_v1))/exp(2*Z) - (S^2.*Y.^3*(S_v1))/(2*exp(Z)) ...
+ (3*S*(S_v1))/(exp(4*Z)*Z^3) - (4*S*(S_v1))/(exp(3*Z)*Z^3) + (S*(S_v1))/(exp(2*Z)*Z^3) + (S*(S_v1))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S*(S_v1))/Z^3 ...
- (4*exp(-Z - 2.*Y.*Z)*S*(S_v1))/Z^3 - (6*exp(-3*Z - Y.*Z)*S*(S_v1))/Z^3 + (8*exp(-2*Z - Y.*Z)*S*(S_v1))/Z^3 - (2*exp(-Z - Y.*Z)*S*(S_v1))/Z^3 ...

$$\begin{aligned}
& + (3*S^2*(S_{v1})/(\exp(4*Z)*Z^3) - (4*S^2*(S_{v1})/(\exp(3*Z)*Z^3) + (S^2*(S_{v1})/(\exp(2*Z)*Z^3) + \\
& (S^2*(S_{v1})/(\exp(2*Y*Z)*Z^3) + (3*\exp(-2*Z - 2*Y*Z)*S^2*(S_{v1})/Z^3 \dots \\
& - (4*\exp(-Z - 2*Y*Z)*S^2*(S_{v1})/Z^3 - (6*\exp(-3*Z - Y*Z)*S^2*(S_{v1})/Z^3 + (8*\exp(-2*Z - \\
& Y*Z)*S^2*(S_{v1})/Z^3 - (2*\exp(-Z - Y*Z)*S^2*(S_{v1})/Z^3 \dots \\
& + (11*S*(S_{v1})/(\exp(3*Z)*Z^2) - (8*S*(S_{v1})/(\exp(2*Z)*Z^2) + (2*S*(S_{v1})/(\exp(Z)*Z^2) - \\
& (S*(S_{v1})/(\exp(3*Y*Z)*Z^2) - (2*S*(S_{v1})/(\exp(Y*Z)*Z^2) \dots \\
& - (\exp(-Z - 2*Y*Z)*S*(S_{v1})/Z^2 - (9*\exp(-2*Z - Y*Z)*S*(S_{v1})/Z^2 + (8*\exp(-Z - \\
& Y*Z)*S*(S_{v1})/Z^2 + (8*S^2*(S_{v1})/(\exp(3*Z)*Z^2); \dots \\
& - (4*S^2*(S_{v1})/(\exp(2*Z)*Z^2) + (S^2*(S_{v1})/(\exp(Z)*Z^2) - (S^2*(S_{v1})/(\exp(3*Y*Z)*Z^2) - \\
& (S^2*(S_{v1})/(\exp(Y*Z)*Z^2) - (\exp(-Z - 2*Y*Z)*S^2*(S_{v1})/Z^2 \dots \\
& - (6*\exp(-2*Z - Y*Z)*S^2*(S_{v1})/Z^2 + (4*\exp(-Z - Y*Z)*S^2*(S_{v1})/Z^2 - \\
& (6*S*Y*(S_{v1})/(\exp(3*Z)*Z^2) + (8*S*Y*(S_{v1})/(\exp(2*Z)*Z^2) \dots \\
& - (2*S*Y*(S_{v1})/(\exp(Z)*Z^2) + (2*S*Y*(S_{v1})/(\exp(Y*Z)*Z^2) + (6*\exp(-2*Z - \\
& Y*Z)*S*Y*(S_{v1})/Z^2 - (8*\exp(-Z - Y*Z)*S*Y*(S_{v1})/Z^2 \dots \\
& - (3*S^2*Y*(S_{v1})/(\exp(3*Z)*Z^2) + (4*S^2*Y*(S_{v1})/(\exp(2*Z)*Z^2) - \\
& (S^2*Y*(S_{v1})/(\exp(Z)*Z^2) + (S^2*Y*(S_{v1})/(\exp(Y*Z)*Z^2) \dots \\
& + (3*\exp(-2*Z - Y*Z)*S^2*Y*(S_{v1})/Z^2 - (4*\exp(-Z - Y*Z)*S^2*Y*(S_{v1})/Z^2 + (S*(S_{v1})/Z \\
& + (2*S*(S_{v1})/(\exp(3*Z)*Z) + (9*S*(S_{v1})/(\exp(2*Z)*Z) \dots \\
& - (4*S*(S_{v1})/(\exp(Z)*Z) + (S*(S_{v1})/(\exp(2*Y*Z)*Z) - (2*\exp(-2*Z - Y*Z)*S*(S_{v1})/Z + \\
& (\exp(-Z - Y*Z)*S*(S_{v1})/Z + (2*S^2*(S_{v1})/(\exp(3*Z)*Z) \dots \\
& + (S^2*(S_{v1})/(\exp(2*Z)*Z) - (2*\exp(-2*Z - Y*Z)*S^2*(S_{v1})/Z - (\exp(-Z - Y*Z)*S^2*(S_{v1})/Z - \\
& (2*S*Y*(S_{v1})/Z - (13*S*Y*(S_{v1})/(\exp(2*Z)*Z) \dots \\
& + (8*S*Y*(S_{v1})/(\exp(Z)*Z) - (S*Y*(S_{v1})/(\exp(2*Y*Z)*Z) - \\
& (2*S^2*Y*(S_{v1})/(\exp(2*Z)*Z) + (2*\exp(-Z - Y*Z)*S^2*Y*(S_{v1})/Z + (S*Y^2*(S_{v1})/Z \dots \\
& + (3*S*Y^2*(S_{v1})/(\exp(4*Z)*Z) - (4*S*Y^2*(S_{v1})/(\exp(3*Z)*Z) + \\
& (4*S*Y^2*(S_{v1})/(\exp(2*Z)*Z) - (4*S*Y^2*(S_{v1})/(\exp(Z)*Z) \dots \\
& - (3*\exp(-3*Z - Y*Z)*S*Y^2*(S_{v1})/Z + (4*\exp(-2*Z - Y*Z)*S*Y^2*(S_{v1})/Z - (\exp(-Z - \\
& Y*Z)*S*Y^2*(S_{v1})/Z + (3*S^2*Y^2*(S_{v1})/(\exp(4*Z)*Z) \dots \\
& - (4*S^2*Y^2*(S_{v1})/(\exp(3*Z)*Z) + (S^2*Y^2*(S_{v1})/(\exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y*Z)*S^2*Y^2*(S_{v1})/Z + (4*\exp(-2*Z - Y*Z)*S^2*Y^2*(S_{v1})/Z \dots \\
& - (\exp(-Z - Y*Z)*S^2*Y^2*(S_{v1})/Z - (3*S^2*Y^2*(S_{v1})/(4*\exp(4*Z)) - (7*S^2*Y^2*(S_{v1})/(4*\exp(2*Z))) \\
& - (3*S^2*Y^2*(S_{v1})/(4*\exp(4*Z)) - (3*S^2*Y^2*(S_{v1})/(4*\exp(2*Z))) \dots \\
& + (2*S*Y*Z*(S_{v1})/exp(2*Z) + (S^2*Y*Z*(S_{v1})/exp(2*Z) + (S*Y^2*Z*(S_{v1})/exp(3*Z) + \\
& (3*S*Y^2*Z*(S_{v1})/(2*\exp(2*Z)) + (S^2*Y^2*Z*(S_{v1})/exp(3*Z) \dots \\
& + (S^2*Y^2*Z*(S_{v1})/(2*\exp(2*Z)) - (2*S*Y^3*Z*(S_{v1})/exp(2*Z) - \\
& (S^2*Y^3*Z*(S_{v1})/exp(2*Z) + (3*S*Y^4*Z*(S_{v1})/(4*\exp(4*Z)) - (S*Y^4*Z*(S_{v1})/exp(3*Z)) \\
& \dots \\
& + (S*Y^4*Z*(S_{v1})/(4*\exp(2*Z)) + (3*S^2*Y^4*Z*(S_{v1})/(4*\exp(4*Z)) - \\
& (S^2*Y^4*Z*(S_{v1})/exp(3*Z) + (S^2*Y^4*Z*(S_{v1})/(4*\exp(2*Z)) + (S*Z^2*(S_{v1})/(2*\exp(3*Z))) \\
& \dots \\
& + (S^2*Z^2*(S_{v1})/(2*\exp(3*Z)) - (S*Y^2*Z^2*(S_{v1})/exp(3*Z) - \\
& (S^2*Y^2*Z^2*(S_{v1})/exp(3*Z) + (S*Y^4*Z^2*(S_{v1})/(2*\exp(3*Z))) \dots \\
& + (S^2*Y^4*Z^2*(S_{v1})/(2*\exp(3*Z)) + (9*S^2*(S_{v1})^2/(16*\exp(6*Z)) - \\
& (23*S^2*(S_{v1})^2/(8*\exp(4*Z)) + (2*S^2*(S_{v1})^2/exp(3*Z) + (S^2*(S_{v1})^2/(16*\exp(2*Z))) \dots \\
& - (\exp(-2*Z - 2*Y*Z)*S^2*(S_{v1})^2/2 - \exp(-3*Z - Y*Z)*S^2*(S_{v1})^2 - \\
& (2*S^2*Y*(S_{v1})^2/exp(3*Z) - (S^2*Y*(S_{v1})^2/exp(2*Z) + (9*S^2*Y^2*(S_{v1})^2/(8*\exp(6*Z))) \\
& \dots \\
& - (3*S^2*Y^2*(S_{v1})^2/(2*\exp(5*Z)) + (11*S^2*Y^2*(S_{v1})^2/(2*\exp(4*Z)) - \\
& (7*S^2*Y^2*(S_{v1})^2/(2*\exp(3*Z)) + (15*S^2*Y^2*(S_{v1})^2/(8*\exp(2*Z))) \dots \\
& + (\exp(-2*Z - 2*Y*Z)*S^2*Y^2*(S_{v1})^2/2 + \exp(-3*Z - Y*Z)*S^2*Y^2*(S_{v1})^2 - \\
& (3*S^2*Y^3*(S_{v1})^2/exp(4*Z) + (4*S^2*Y^3*(S_{v1})^2/exp(3*Z) \dots \\
& - (S^2*Y^3*(S_{v1})^2/exp(2*Z) + (9*S^2*Y^4*(S_{v1})^2/(16*\exp(6*Z)) - \\
& (3*S^2*Y^4*(S_{v1})^2/(2*\exp(5*Z)) + (11*S^2*Y^4*(S_{v1})^2/(8*\exp(4*Z))) \dots \\
& - (S^2*Y^4*(S_{v1})^2/(2*\exp(3*Z)) + (S^2*Y^4*(S_{v1})^2/(16*\exp(2*Z)) + \\
& (9*S^2*(S_{v1})^2/(4*\exp(6*Z)*Z^4) - (6*S^2*(S_{v1})^2/(exp(5*Z)*Z^4) \dots
\end{aligned}$$

$$\begin{aligned}
& + (11*S^2*(S_{v1})^2)/(2*\exp(4*Z)*Z^4) - (2*S^2*(S_{v1})^2)/(\exp(3*Z)*Z^4) + \\
& (S^2*(S_{v1})^2)/(4*\exp(2*Z)*Z^4) + (S^2*(S_{v1})^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v1})^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^4 - (\exp(-Z - Y.*Z)*S^2*(S_{v1})^2)/(2*Z^4) + \\
& (12*S^2*(S_{v1})^2)/(\exp(5*Z)*Z^3) - (22*S^2*(S_{v1})^2)/(\exp(4*Z)*Z^3) ... \\
& + (27*S^2*(S_{v1})^2)/(2*\exp(3*Z)*Z^3) - (4*S^2*(S_{v1})^2)/(\exp(2*Z)*Z^3) + \\
& (S^2*(S_{v1})^2)/(2*\exp(Z)*Z^3) - (S^2*(S_{v1})^2)/(2*\exp(3.*Y.*Z)*Z^3) ... \\
& - (S^2*(S_{v1})^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S^2*(S_{v1})^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_{v1})^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_{v1})^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_{v1})^2)/Z^3 - \\
& (9*S^2.*Y.*(S_{v1})^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_{v1})^2)/(\exp(4*Z)*Z^3) ... \\
& - (11*S^2.*Y.*(S_{v1})^2)/(\exp(3*Z)*Z^3) + (4*S^2.*Y.*(S_{v1})^2)/(\exp(2*Z)*Z^3) - \\
& (S^2.*Y.*(S_{v1})^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_{v1})^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_{v1})^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z^3 ... \\
& - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z^3 + (S^2*(S_{v1})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v1})^2)/(4*\exp(6*Z)*Z^2) - (3*S^2*(S_{v1})^2)/(\exp(5*Z)*Z^2) + \\
& (19*S^2*(S_{v1})^2)/(\exp(4*Z)*Z^2) ... \\
& - (19*S^2*(S_{v1})^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_{v1})^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_{v1})^2)/(\exp(Z)*Z^2) + (S^2*(S_{v1})^2)/(4*\exp(4.*Y.*Z)*Z^2) ... \\
& + (S^2*(S_{v1})^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S^2*(S_{v1})^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S^2*(S_{v1})^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/Z^2 ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v1})^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_{v1})^2)/Z^2 ... \\
& + (\exp(-Z - Y.*Z)*S^2*(S_{v1})^2)/(4*Z^2) - (S^2.*Y.*(S_{v1})^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_{v1})^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_{v1})^2)/(\exp(3*Z)*Z^2) ... \\
& - (29*S^2.*Y.*(S_{v1})^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_{v1})^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_{v1})^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.*(S_{v1})^2)/(2*Z^2) ... \\
& + (2*\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z^2 + (S^2.*Y.^2*(S_{v1})^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_{v1})^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_{v1})^2)/(\exp(5*Z)*Z^2) ... \\
& + (31*S^2.*Y.^2*(S_{v1})^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_{v1})^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_{v1})^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_{v1})^2)/(\exp(Z)*Z^2) ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/(2*Z^2) ... \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v1})^2)/(2*\exp(5*Z)*Z) - (S^2*(S_{v1})^2)/(\exp(4*Z)*Z) ... \\
& + (25*S^2*(S_{v1})^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_{v1})^2)/(\exp(2*Z)*Z) + \\
& (3*S^2*(S_{v1})^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(4*Z) ... \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v1})^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v1})^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_{v1})^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_{v1})^2)/Z ... \\
& - (9*S^2.*Y.*(S_{v1})^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_{v1})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_{v1})^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_{v1})^2)/(\exp(2*Z)*Z) ... \\
& - (7*S^2.*Y.*(S_{v1})^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_{v1})^2)/Z + (15*S^2.*Y.^2*(S_{v1})^2)/(2*\exp(5*Z)*Z) ... \\
& - (13*S^2.*Y.^2*(S_{v1})^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_{v1})^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_{v1})^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_{v1})^2)/(4*\exp(Z)*Z) ... \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/Z \\
& + (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v1})^2)/(4*Z) ... \\
& - (9*S^2.*Y.^3*(S_{v1})^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_{v1})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_{v1})^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_{v1})^2)/(\exp(2*Z)*Z) ...
\end{aligned}$$

$$\begin{aligned}
& - \frac{(S^2 * Y.^3 * (S_{v1})^2)/(4 * \exp(Z) * Z)}{(3 * S^2 * Z * (S_{v1})^2)/(4 * \exp(3 * Z))} - \frac{(3 * S^2 * Z * (S_{v1})^2)/(4 * \exp(5 * Z))}{(S^2 * Y.^2 * Z * (S_{v1})^2)/\exp(3 * Z)} - \\
& (S^2 * Y.^2 * Z * (S_{v1})^2)/\exp(4 * Z) \dots + \frac{(S^2 * Y.^2 * Z * (S_{v1})^2)/(2 * \exp(3 * Z))}{(3 * S^2 * Y.^4 * Z * (S_{v1})^2)/(4 * \exp(5 * Z))} - \frac{(S^2 * Y.^4 * Z * (S_{v1})^2)/\exp(4 * Z)}{\dots} \\
& + \frac{(S^2 * Y.^4 * Z * (S_{v1})^2)/(4 * \exp(3 * Z))}{(S^2 * Z^2 * (S_{v1})^2)/(4 * \exp(4 * Z))} - \frac{(S^2 * Y.^2 * Z^2 * (S_{v1})^2)/(2 * \exp(4 * Z))}{(S^2 * Y.^4 * Z^2 * (S_{v1})^2)/(4 * \exp(4 * Z))};
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf + Nc + Ny1; \\
Phi1 &= Nf. / [Nc + Ny1]; \\
Be1 &= 1. / [1 + Phi1]; \\
Gf1 &= Nf. / Ns1; \\
Gh1 &= [Nc + Ny1] / Ns1; \\
Nh1 &= Nc + Ny1;
\end{aligned}$$

$$\begin{aligned}
S_{v2} &= 2; \\
Ny2 &= 1 - \exp(-2 * Z) + \exp(-Z - Y * Z) - (2 * S) / \exp(2 * Z) + 2 * \exp(-Z - Y * Z) * S - S^2 / \exp(2 * Z) + \exp(-Z - Y * Z) * S^2 - 2 * Y + Y.^2 + Y.^2 / \exp(2 * Z) - \exp(-Z - Y * Z) * Y.^2 \dots \\
& + (2 * S * Y.^2) / \exp(2 * Z) - 2 * \exp(-Z - Y * Z) * S * Y.^2 + (S^2 * Y.^2) / \exp(2 * Z) - \exp(-Z - Y * Z) * S^2 * Y.^2 + 1 / (\exp(2 * Z) * Z^2) + 1 / (\exp(2 * Y * Z) * Z^2) \dots \\
& - (2 * \exp(-Z - Y * Z)) / Z^2 + (2 * S) / (\exp(2 * Z) * Z^2) + (2 * S) / (\exp(2 * Y * Z) * Z^2) - (4 * \exp(-Z - Y * Z) * S) / Z^2 + S^2 / (\exp(2 * Z) * Z^2) + S^2 / (\exp(2 * Y * Z) * Z^2) \dots \\
& - (2 * \exp(-Z - Y * Z) * S^2) / Z^2 + 2 / (\exp(Z) * Z) - 2 / (\exp(Y * Z) * Z) + (2 * S) / (\exp(Z) * Z) - (2 * S) / (\exp(Y * Z) * Z) - (2 * Y) / (\exp(Z) * Z) + (2 * Y) / (\exp(Y * Z) * Z) \dots \\
& - (2 * S * Y) / (\exp(Z) * Z) + (2 * S * Y) / (\exp(Y * Z) * Z) - Z / \exp(Z) - (S * Z) / \exp(Z) + (Y * Z) / \exp(Z) + (S * Y * Z) / \exp(Z) + (Y.^2 * Z) / \exp(Z) + (S * Y.^2 * Z) / \exp(Z) - (Y.^3 * Z) / \exp(Z) \dots \\
& - (S * Y.^3 * Z) / \exp(Z) + Z^2 / (4 * \exp(2 * Z)) + (S * Z^2) / (2 * \exp(2 * Z)) + (S^2 * Z^2) / (4 * \exp(2 * Z)) - (Y.^2 * Z^2) / (2 * \exp(2 * Z)) - (S * Y.^2 * Z^2) / \exp(2 * Z) \dots \\
& - (S^2 * Y.^2 * Z^2) / (2 * \exp(2 * Z)) + (Y.^4 * Z^2) / (4 * \exp(2 * Z)) + (S * Y.^4 * Z^2) / (2 * \exp(2 * Z)) + (S^2 * Y.^4 * Z^2) / (4 * \exp(2 * Z)) - (7 * S * (S_{v2})) / (2 * \exp(3 * Z)) \dots \\
& + (2 * S * (S_{v2})) / \exp(2 * Z) + (S * (S_{v2})) / \exp(Z) - (\exp(-Z - 2 * Y * Z) * S * (S_{v2})) / 2 - (5 * S^2 * (S_{v2})) / \exp(3 * Z) + (2 * S^2 * (S_{v2})) / \exp(2 * Z) - (S^2 * (S_{v2})) / (2 * \exp(Z)) \dots \\
& - (\exp(-Z - 2 * Y * Z) * S^2 * (S_{v2})) / 2 - (2 * S * Y * (S_{v2})) / \exp(2 * Z) - (3 * S * Y * (S_{v2})) / \exp(Z) + (3 * S^2 * Y * (S_{v2})) / (2 * \exp(3 * Z)) - (2 * S^2 * Y * (S_{v2})) / \exp(2 * Z) \dots \\
& + (S^2 * Y * (S_{v2})) / (2 * \exp(Z)) + (13 * S * Y.^2 * (S_{v2})) / (2 * \exp(3 * Z)) - (4 * S * Y.^2 * (S_{v2})) / \exp(2 * Z) + (3 * S * Y.^2 * (S_{v2})) / \exp(Z) + (\exp(-Z - 2 * Y * Z) * S * Y.^2 * (S_{v2})) / 2 \dots \\
& + (5 * S^2 * Y.^2 * (S_{v2})) / \exp(3 * Z) - (2 * S^2 * Y.^2 * (S_{v2})) / \exp(2 * Z) + (S^2 * Y.^2 * (S_{v2})) / (2 * \exp(Z)) + (\exp(-Z - 2 * Y * Z) * S^2 * Y.^2 * (S_{v2})) / 2 - (3 * S * Y.^3 * (S_{v2})) / \exp(3 * Z) \dots \\
& + (4 * S * Y.^3 * (S_{v2})) / \exp(2 * Z) - (S * Y.^3 * (S_{v2})) / \exp(Z) - (3 * S^2 * Y.^3 * (S_{v2})) / (2 * \exp(3 * Z)) + (2 * S^2 * Y.^3 * (S_{v2})) / \exp(2 * Z) - (S^2 * Y.^3 * (S_{v2})) / (2 * \exp(Z)) \dots \\
& + (3 * S * (S_{v2})) / (\exp(4 * Z) * Z^3) - (4 * S * (S_{v2})) / (\exp(3 * Z) * Z^3) + (S * (S_{v2})) / (\exp(2 * Z) * Z^3) + (S * (S_{v2})) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S * (S_{v2})) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S * (S_{v2})) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S * (S_{v2})) / Z^3 + (8 * \exp(-2 * Z - Y * Z) * S * (S_{v2})) / Z^3 - (2 * \exp(-Z - Y * Z) * S * (S_{v2})) / Z^3 \dots \\
& + (3 * S^2 * (S_{v2})) / (\exp(4 * Z) * Z^3) - (4 * S^2 * (S_{v2})) / (\exp(3 * Z) * Z^3) + (S^2 * (S_{v2})) / (\exp(2 * Z) * Z^3) + (S^2 * (S_{v2})) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S^2 * (S_{v2})) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S^2 * (S_{v2})) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S^2 * (S_{v2})) / Z^3 + (8 * \exp(-2 * Z - Y * Z) * S^2 * (S_{v2})) / Z^3 - (2 * \exp(-Z - Y * Z) * S^2 * (S_{v2})) / Z^3 \dots \\
& + (11 * S * (S_{v2})) / (\exp(3 * Z) * Z^2) - (8 * S * (S_{v2})) / (\exp(2 * Z) * Z^2) + (2 * S * (S_{v2})) / (\exp(Z) * Z^2) - (S * (S_{v2})) / (\exp(3 * Y * Z) * Z^2) - (2 * S * (S_{v2})) / (\exp(Y * Z) * Z^2) \dots \\
& - (\exp(-Z - 2 * Y * Z) * S * (S_{v2})) / Z^2 - (9 * \exp(-2 * Z - Y * Z) * S * (S_{v2})) / Z^2 + (8 * \exp(-Z - Y * Z) * S * (S_{v2})) / Z^2 + (8 * S^2 * (S_{v2})) / (\exp(3 * Z) * Z^2); \dots \\
& - (4 * S^2 * (S_{v2})) / (\exp(2 * Z) * Z^2) + (S^2 * (S_{v2})) / (\exp(Z) * Z^2) - (S^2 * (S_{v2})) / (\exp(3 * Y * Z) * Z^2) - (S^2 * (S_{v2})) / (\exp(Y * Z) * Z^2) - (\exp(-Z - 2 * Y * Z) * S^2 * (S_{v2})) / Z^2 \dots
\end{aligned}$$

$$\begin{aligned}
& - (6*\exp(-2*Z - Y.*Z))*S^2*(S_v2))/Z^2 + (4*\exp(-Z - Y.*Z))*S^2*(S_v2))/Z^2 - \\
& (6*S.*Y.*(S_v2))/(exp(3*Z)*Z^2) + (8*S.*Y.*(S_v2))/(exp(2*Z)*Z^2) ... \\
& - (2*S.*Y.*(S_v2))/(exp(Z)*Z^2) + (2*S.*Y.*(S_v2))/(exp(Y.*Z)*Z^2) + (6*\exp(-2*Z - \\
& Y.*Z))*S.*Y.*(S_v2))/Z^2 - (8*\exp(-Z - Y.*Z))*S.*Y.*(S_v2))/Z^2 ... \\
& - (3*S^2.*Y.*(S_v2))/(exp(3*Z)*Z^2) + (4*S^2.*Y.*(S_v2))/(exp(2*Z)*Z^2) - \\
& (S^2.*Y.*(S_v2))/(exp(Z)*Z^2) + (S^2.*Y.*(S_v2))/(exp(Y.*Z)*Z^2) ... \\
& + (3*\exp(-2*Z - Y.*Z))*S^2.*Y.*(S_v2))/Z^2 - (4*\exp(-Z - Y.*Z))*S^2.*Y.*(S_v2))/Z^2 + (S*(S_v2))/Z \\
& + (2*S*(S_v2))/(exp(3*Z)*Z) + (9*S*(S_v2))/(exp(2*Z)*Z) ... \\
& - (4*S*(S_v2))/(exp(Z)*Z) + (S*(S_v2))/(exp(2.*Y.*Z)*Z) - (2*\exp(-2*Z - Y.*Z))*S*(S_v2))/Z + \\
& (exp(-Z - Y.*Z))*S*(S_v2))/Z + (2*S^2*(S_v2))/(exp(3*Z)*Z) ... \\
& + (S^2*(S_v2))/(exp(2*Z)*Z) - (2*\exp(-2*Z - Y.*Z))*S^2*(S_v2))/Z - (exp(-Z - Y.*Z))*S^2*(S_v2))/Z - \\
& (2*S.*Y.*(S_v2))/Z - (13*S.*Y.*(S_v2))/(exp(2*Z)*Z) ... \\
& + (8*S.*Y.*(S_v2))/(exp(Z)*Z) - (S.*Y.*(S_v2))/(exp(2.*Y.*Z)*Z) - \\
& (2*S^2.*Y.*(S_v2))/(exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z))*S^2.*Y.*(S_v2))/Z + (S.*Y.^2*(S_v2))/Z ... \\
& + (3*S.*Y.^2*(S_v2))/(exp(4*Z)*Z) - (4*S.*Y.^2*(S_v2))/(exp(3*Z)*Z) + \\
& (4*S.*Y.^2*(S_v2))/(exp(2*Z)*Z) - (4*S.*Y.^2*(S_v2))/(exp(Z)*Z) ... \\
& - (3*\exp(-3*Z - Y.*Z))*S.*Y.^2*(S_v2))/Z + (4*\exp(-2*Z - Y.*Z))*S.*Y.^2*(S_v2))/Z - (exp(-Z - \\
& Y.*Z))*S.*Y.^2*(S_v2))/Z + (3*S^2.*Y.^2*(S_v2))/(exp(4*Z)*Z) ... \\
& - (4*S^2.*Y.^2*(S_v2))/(exp(3*Z)*Z) + (S^2.*Y.^2*(S_v2))/(exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z))*S^2.*Y.^2*(S_v2))/Z + (4*\exp(-2*Z - Y.*Z))*S^2.*Y.^2*(S_v2))/Z ... \\
& - (exp(-Z - Y.*Z))*S^2.*Y.^2*(S_v2))/Z - (3*S^2*(S_v2))/(4*\exp(4*Z)) - (7*S^2*(S_v2))/(4*\exp(2*Z)) \\
& - (3*S^2*Z*(S_v2))/(4*\exp(4*Z)) - (3*S^2*Z*(S_v2))/(4*\exp(2*Z)) ... \\
& + (2*S.*Y.*Z*(S_v2))/exp(2*Z) + (S^2.*Y.*Z*(S_v2))/exp(2*Z) + (S.*Y.^2*Z*(S_v2))/exp(3*Z) + \\
& (3*S.*Y.^2*Z*(S_v2))/(2*\exp(2*Z)) + (S^2.*Y.^2*Z*(S_v2))/exp(3*Z) ... \\
& + (S^2.*Y.^2*Z*(S_v2))/(2*\exp(2*Z)) - (2*S.*Y.^3*Z*(S_v2))/exp(2*Z) - \\
& (S^2.*Y.^3*Z*(S_v2))/exp(2*Z) + (3*S.*Y.^4*Z*(S_v2))/(4*\exp(4*Z)) - (S.*Y.^4*Z*(S_v2))/exp(3*Z) \\
& ... \\
& + (S.*Y.^4*Z*(S_v2))/(4*\exp(2*Z)) + (3*S^2.*Y.^4*Z*(S_v2))/(4*\exp(4*Z)) - \\
& (S^2.*Y.^4*Z*(S_v2))/exp(3*Z) + (S^2.*Y.^4*Z*(S_v2))/(4*\exp(2*Z)) + (S*Z^2*(S_v2))/(2*\exp(3*Z)) \\
& ... \\
& + (S^2*Z^2*(S_v2))/(2*\exp(3*Z)) - (S.*Y.^2*Z^2*(S_v2))/exp(3*Z) - \\
& (S^2.*Y.^2*Z^2*(S_v2))/exp(3*Z) + (S.*Y.^4*Z^2*(S_v2))/(2*\exp(3*Z)) ... \\
& + (S^2.*Y.^4*Z^2*(S_v2))/(2*\exp(3*Z)) + (9*S^2*(S_v2)^2)/(16*\exp(6*Z)) - \\
& (23*S^2*(S_v2)^2)/(8*\exp(4*Z)) + (2*S^2*(S_v2)^2)/exp(3*Z) + (S^2*(S_v2)^2)/(16*\exp(2*Z)) ... \\
& - (exp(-2*Z - 2.*Y.*Z))*S^2*(S_v2)^2/2 - exp(-3*Z - Y.*Z))*S^2*(S_v2)^2 - \\
& (2*S^2.*Y.*(S_v2)^2)/exp(3*Z) - (S^2.*Y.*(S_v2)^2)/exp(2*Z) + (9*S^2.*Y.^2*(S_v2)^2)/(8*\exp(6*Z)) \\
& ... \\
& - (3*S^2.*Y.^2*(S_v2)^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^2*(S_v2)^2)/(2*\exp(4*Z)) - \\
& (7*S^2.*Y.^2*(S_v2)^2)/(2*\exp(3*Z)) + (15*S^2.*Y.^2*(S_v2)^2)/(8*\exp(2*Z)) ... \\
& + (exp(-2*Z - 2.*Y.*Z))*S^2.*Y.^2*(S_v2)^2/2 + exp(-3*Z - Y.*Z))*S^2.*Y.^2*(S_v2)^2 - \\
& (3*S^2.*Y.^3*(S_v2)^2)/exp(4*Z) + (4*S^2.*Y.^3*(S_v2)^2)/exp(3*Z) ... \\
& - (S^2.*Y.^3*(S_v2)^2)/exp(2*Z) + (9*S^2.*Y.^4*(S_v2)^2)/(16*\exp(6*Z)) - \\
& (3*S^2.*Y.^4*(S_v2)^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^4*(S_v2)^2)/(8*\exp(4*Z)) ... \\
& - (S^2.*Y.^4*(S_v2)^2)/(2*\exp(3*Z)) + (S^2.*Y.^4*(S_v2)^2)/(16*\exp(2*Z)) + \\
& (9*S^2*(S_v2)^2)/(4*\exp(6*Z)*Z^4) - (6*S^2*(S_v2)^2)/(exp(5*Z)*Z^4) ... \\
& + (11*S^2*(S_v2)^2)/(2*\exp(4*Z)*Z^4) - (2*S^2*(S_v2)^2)/(exp(3*Z)*Z^4) + \\
& (S^2*(S_v2)^2)/(4*\exp(2*Z)*Z^4) + (S^2*(S_v2)^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z))*S^2*(S_v2)^2/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z))*S^2*(S_v2)^2/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z))*S^2*(S_v2)^2/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z))*S^2*(S_v2)^2/Z^4 - (9*\exp(-5*Z - Y.*Z))*S^2*(S_v2)^2/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z))*S^2*(S_v2)^2/Z^4 - (11*\exp(-3*Z - Y.*Z))*S^2*(S_v2)^2/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z))*S^2*(S_v2)^2/Z^4 - (exp(-Z - Y.*Z))*S^2*(S_v2)^2/(2*Z^4) + \\
& (12*S^2*(S_v2)^2)/(exp(5*Z)*Z^3) - (22*S^2*(S_v2)^2)/(exp(4*Z)*Z^3) ... \\
& + (27*S^2*(S_v2)^2)/(2*\exp(3*Z)*Z^3) - (4*S^2*(S_v2)^2)/(exp(2*Z)*Z^3) + \\
& (S^2*(S_v2)^2)/(2*\exp(Z)*Z^3) - (S^2*(S_v2)^2)/(2*\exp(3.*Y.*Z)*Z^3) ...
\end{aligned}$$

$$\begin{aligned}
& - (S^2*(S_{v2})^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S^2*(S_{v2})^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_{v2})^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_{v2})^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_{v2})^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_{v2})^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_{v2})^2)/Z^3 - \\
& (9*S^2.*Y.*(S_{v2})^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_{v2})^2)/(\exp(4*Z)*Z^3) ... \\
& - (11*S^2.*Y.*(S_{v2})^2)/(\exp(3*Z)*Z^3) + (4*S^2.*Y.*(S_{v2})^2)/(\exp(2*Z)*Z^3) - \\
& (S^2.*Y.*(S_{v2})^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_{v2})^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_{v2})^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z^3 ... \\
& - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z^3 + (S^2*(S_{v2})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v2})^2)/(4*\exp(6*Z)*Z^2) - (3*S^2*(S_{v2})^2)/(\exp(5*Z)*Z^2) + \\
& (19*S^2*(S_{v2})^2)/(\exp(4*Z)*Z^2) ... \\
& - (19*S^2*(S_{v2})^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_{v2})^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_{v2})^2)/(\exp(Z)*Z^2) + (S^2*(S_{v2})^2)/(4*\exp(4.*Y.*Z)*Z^2) ... \\
& + (S^2*(S_{v2})^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S^2*(S_{v2})^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S^2*(S_{v2})^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/Z^2 ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v2})^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v2})^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S^2*(S_{v2})^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_{v2})^2)/Z^2 ... \\
& + (\exp(-Z - Y.*Z)*S^2*(S_{v2})^2)/(4*Z^2) - (S^2.*Y.*(S_{v2})^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_{v2})^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_{v2})^2)/(\exp(3*Z)*Z^2) ... \\
& - (29*S^2.*Y.*(S_{v2})^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_{v2})^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_{v2})^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.*(S_{v2})^2)/(2*Z^2) ... \\
& + (2*\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z^2 + (S^2.*Y.^2*(S_{v2})^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_{v2})^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_{v2})^2)/(\exp(5*Z)*Z^2) ... \\
& + (31*S^2.*Y.^2*(S_{v2})^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_{v2})^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_{v2})^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_{v2})^2)/(\exp(Z)*Z^2) ... \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/(2*Z^2) ... \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v2})^2)/(2*\exp(5*Z)*Z) - (S^2*(S_{v2})^2)/(\exp(4*Z)*Z) ... \\
& + (25*S^2*(S_{v2})^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_{v2})^2)/(\exp(2*Z)*Z) + \\
& (3*S^2*(S_{v2})^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/(4*Z) ... \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v2})^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v2})^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_{v2})^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_{v2})^2)/Z ... \\
& - (9*S^2.*Y.*(S_{v2})^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_{v2})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_{v2})^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_{v2})^2)/(\exp(2*Z)*Z) ... \\
& - (7*S^2.*Y.*(S_{v2})^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_{v2})^2)/Z + (15*S^2.*Y.^2*(S_{v2})^2)/(2*\exp(5*Z)*Z) ... \\
& - (13*S^2.*Y.^2*(S_{v2})^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_{v2})^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_{v2})^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_{v2})^2)/(4*\exp(Z)*Z) ... \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/Z \\
& + (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v2})^2)/(4*Z) ... \\
& - (9*S^2.*Y.^3*(S_{v2})^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_{v2})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_{v2})^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_{v2})^2)/(\exp(2*Z)*Z) ... \\
& - (S^2.*Y.^3*(S_{v2})^2)/(4*\exp(Z)*Z) - (3*S^2*Z*(S_{v2})^2)/(4*\exp(5*Z)) - \\
& (3*S^2*Z*(S_{v2})^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_{v2})^2)/\exp(3*Z) + \\
& (S^2.*Y.^2*Z*(S_{v2})^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^2*Z*(S_{v2})^2)/(2*\exp(3*Z)) - (S^2.*Y.^3*Z*(S_{v2})^2)/\exp(3*Z) + \\
& (3*S^2.*Y.^4*Z*(S_{v2})^2)/(4*\exp(5*Z)) - (S^2.*Y.^4*Z*(S_{v2})^2)/\exp(4*Z) ... \\
& + (S^2.*Y.^4*Z*(S_{v2})^2)/(4*\exp(3*Z)) + (S^2*Z^2*(S_{v2})^2)/(4*\exp(4*Z)) - \\
& (S^2.*Y.^2*Z^2*(S_{v2})^2)/(2*\exp(4*Z)) + (S^2.*Y.^4*Z^2*(S_{v2})^2)/(4*\exp(4*Z));
\end{aligned}$$

$$\begin{aligned}
Ns2 &= Nf + Nc + Ny2; \\
Phi2 &= Nf./[Nc + Ny2]; \\
Be2 &= 1./[1 + Phi2];
\end{aligned}$$

Gf2=Nf./Ns2;
 Gh2=[Nc+Ny2]./Ns2;
 Nh2=Nc+Ny2;

S_v3=3;
 Ny3=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S - S^2/exp(2*Z) + exp(-Z - Y.*Z)*S^2 - 2.*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z)*Y.^2 ...
 + (2*S.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2.*Y.*Z)*Z^2) ...
 - (2*exp(-Z - Y.*Z))/Z^2 + (2*S)/(exp(2*Z)*Z^2) + (2*S)/(exp(2.*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S)/Z^2 + S^2/(exp(2*Z)*Z^2) + S^2/(exp(2.*Y.*Z)*Z^2) ...
 - (2*exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(exp(Z)*Z) - 2/(exp(Y.*Z)*Z) + (2*S)/(exp(Z)*Z) - (2*S)/(exp(Y.*Z)*Z) - (2.*Y)/(exp(Z)*Z) + (2.*Y)/(exp(Y.*Z)*Z) ...
 - (2*S.*Y)/(exp(Z)*Z) + (2*S.*Y)/(exp(Y.*Z)*Z) - Z/exp(Z) - (S*Z)/exp(Z) + (Y.*Z)/exp(Z) + (S.*Y.*Z)/exp(Z) + (Y.^2*Z)/exp(Z) + (S.*Y.^2*Z)/exp(Z) - (Y.^3*Z)/exp(Z) ...
 - (S.*Y.^3*Z)/exp(Z) + Z^2/(4*exp(2*Z)) + (S*Z^2)/(2*exp(2*Z)) + (S^2*Z^2)/(4*exp(2*Z)) - (Y.^2*Z^2)/(2*exp(2*Z)) - (S.*Y.^2*Z^2)/exp(2*Z) ...
 - (S^2.*Y.^2*Z^2)/(2*exp(2*Z)) + (Y.^4*Z^2)/(4*exp(2*Z)) + (S.*Y.^4*Z^2)/(2*exp(2*Z)) + (S^2.*Y.^4*Z^2)/(4*exp(2*Z)) - (7*S*(S_v3))/(2*exp(3*Z)) ...
 + (2*S*(S_v3))/exp(2*Z) + (S*(S_v3))/exp(Z) - (exp(-Z - 2.*Y.*Z)*S*(S_v3))/2 - (5*S^2*(S_v3))/exp(3*Z) + (2*S^2*(S_v3))/exp(2*Z) - (S^2*(S_v3))/(2*exp(Z)) ...
 - (exp(-Z - 2.*Y.*Z)*S^2*(S_v3))/2 - (2*S.*Y*(S_v3))/exp(2*Z) - (3*S.*Y*(S_v3))/exp(Z) + (3*S^2.*Y*(S_v3))/(2*exp(3*Z)) - (2*S^2.*Y*(S_v3))/exp(2*Z) ...
 + (S^2.*Y*(S_v3))/(2*exp(Z)) + (13*S.*Y.^2*(S_v3))/(2*exp(3*Z)) - (4*S.*Y.^2*(S_v3))/exp(2*Z) + (3*S.*Y.^2*(S_v3))/exp(Z) + (exp(-Z - 2.*Y.*Z)*S.*Y.^2*(S_v3))/2 ...
 + (5*S^2.*Y.^2*(S_v3))/exp(3*Z) - (2*S^2.*Y.^2*(S_v3))/exp(2*Z) + (S^2.*Y.^2*(S_v3))/(2*exp(Z)) + (exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v3))/2 - (3*S.*Y.^3*(S_v3))/exp(3*Z) ...
 + (4*S.*Y.^3*(S_v3))/exp(2*Z) - (S.*Y.^3*(S_v3))/exp(Z) - (3*S^2.*Y.^3*(S_v3))/(2*exp(3*Z)) + (2*S^2.*Y.^3*(S_v3))/exp(2*Z) - (S^2.*Y.^3*(S_v3))/(2*exp(Z)) ...
 + (3*S*(S_v3))/(exp(4*Z)*Z^3) - (4*S*(S_v3))/(exp(3*Z)*Z^3) + (S*(S_v3))/(exp(2*Z)*Z^3) + (S*(S_v3))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S*(S_v3))/Z^3 ...
 - (4*exp(-Z - 2.*Y.*Z)*S*(S_v3))/Z^3 - (6*exp(-3*Z - Y.*Z)*S*(S_v3))/Z^3 + (8*exp(-2*Z - Y.*Z)*S*(S_v3))/Z^3 - (2*exp(-Z - Y.*Z)*S*(S_v3))/Z^3 ...
 + (3*S^2*(S_v3))/(exp(4*Z)*Z^3) - (4*S^2*(S_v3))/(exp(3*Z)*Z^3) + (S^2*(S_v3))/(exp(2*Z)*Z^3) + (S^2*(S_v3))/(exp(2.*Y.*Z)*Z^3) + (3*exp(-2*Z - 2.*Y.*Z)*S^2*(S_v3))/Z^3 ...
 - (4*exp(-Z - 2.*Y.*Z)*S^2*(S_v3))/Z^3 - (6*exp(-3*Z - Y.*Z)*S^2*(S_v3))/Z^3 + (8*exp(-2*Z - Y.*Z)*S^2*(S_v3))/Z^3 - (2*exp(-Z - Y.*Z)*S^2*(S_v3))/Z^3 ...
 + (11*S*(S_v3))/(exp(3*Z)*Z^2) - (8*S*(S_v3))/(exp(2*Z)*Z^2) + (2*S*(S_v3))/(exp(Z)*Z^2) - (S*(S_v3))/(exp(3.*Y.*Z)*Z^2) - (2*S*(S_v3))/(exp(Y.*Z)*Z^2) ...
 - (exp(-Z - 2.*Y.*Z)*S*(S_v3))/Z^2 - (9*exp(-2*Z - Y.*Z)*S*(S_v3))/Z^2 + (8*exp(-Z - Y.*Z)*S*(S_v3))/Z^2 + (8*S^2*(S_v3))/(exp(3*Z)*Z^2); ...
 - (4*S^2*(S_v3))/(exp(2*Z)*Z^2) + (S^2*(S_v3))/(exp(Z)*Z^2) - (S^2*(S_v3))/(exp(3.*Y.*Z)*Z^2) - (S^2*(S_v3))/(exp(Y.*Z)*Z^2) - (exp(-Z - 2.*Y.*Z)*S^2*(S_v3))/Z^2 ...
 - (6*exp(-2*Z - Y.*Z)*S^2*(S_v3))/Z^2 + (4*exp(-Z - Y.*Z)*S^2*(S_v3))/Z^2 - (6*S.*Y*(S_v3))/(exp(3*Z)*Z^2) + (8*S.*Y*(S_v3))/(exp(2*Z)*Z^2) ...
 - (2*S.*Y*(S_v3))/(exp(Z)*Z^2) + (2*S.*Y*(S_v3))/(exp(Y.*Z)*Z^2) + (6*exp(-2*Z - Y.*Z)*S.*Y*(S_v3))/Z^2 - (8*exp(-Z - Y.*Z)*S.*Y*(S_v3))/Z^2 ...
 - (3*S^2.*Y*(S_v3))/(exp(3*Z)*Z^2) + (4*S^2.*Y*(S_v3))/(exp(2*Z)*Z^2) - (S^2.*Y*(S_v3))/(exp(Z)*Z^2) + (S^2.*Y*(S_v3))/(exp(Y.*Z)*Z^2) ...
 + (3*exp(-2*Z - Y.*Z)*S^2.*Y*(S_v3))/Z^2 - (4*exp(-Z - Y.*Z)*S^2.*Y*(S_v3))/Z^2 + (S*(S_v3))/Z + (2*S*(S_v3))/(exp(3*Z)*Z) + (9*S*(S_v3))/(exp(2*Z)*Z) ...
 - (4*S*(S_v3))/(exp(Z)*Z) + (S*(S_v3))/(exp(2.*Y.*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S*(S_v3))/Z + (exp(-Z - Y.*Z)*S*(S_v3))/Z + (2*S^2*(S_v3))/(exp(3*Z)*Z) ...
 + (S^2*(S_v3))/(exp(2*Z)*Z) - (2*exp(-2*Z - Y.*Z)*S^2*(S_v3))/Z - (exp(-Z - Y.*Z)*S^2*(S_v3))/Z - (2*S.*Y*(S_v3))/Z - (13*S.*Y*(S_v3))/(exp(2*Z)*Z) ...

$$\begin{aligned}
& + \frac{(8*S.*Y.*(S_v3))}{(\exp(Z)*Z)} - \frac{(S.*Y.*(S_v3))}{(\exp(2.*Y.*Z)*Z)} - \\
& (2*S^2.*Y.*(S_v3))/(\exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v3))/Z + (S.*Y.^2*(S_v3))/Z ... \\
& + \frac{(3*S.*Y.^2*(S_v3))}{(\exp(4*Z)*Z)} - \frac{(4*S.*Y.^2*(S_v3))}{(\exp(3*Z)*Z)} + \\
& (4*S.*Y.^2*(S_v3))/(\exp(2*Z)*Z) - (4*S.*Y.^2*(S_v3))/(\exp(Z)*Z) ... \\
& - (3*\exp(-3*Z - Y.*Z)*S.*Y.^2*(S_v3))/Z + (4*\exp(-2*Z - Y.*Z)*S.*Y.^2*(S_v3))/Z - (\exp(-Z - \\
& Y.*Z)*S.*Y.^2*(S_v3))/Z + (3*S^2.*Y.^2*(S_v3))/(\exp(4*Z)*Z) ... \\
& - (4*S^2.*Y.^2*(S_v3))/(\exp(3*Z)*Z) + (S^2.*Y.^2*(S_v3))/(\exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z)*S^2.*Y.^2*(S_v3))/Z + (4*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v3))/Z ... \\
& - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v3))/Z - (3*S^2.*Z*(S_v3))/(4*\exp(4*Z)) - (7*S^2.*Z*(S_v3))/(4*\exp(2*Z)) \\
& - (3*S^2.*Z*(S_v3))/(4*\exp(4*Z)) - (3*S^2.*Z*(S_v3))/(4*\exp(2*Z)) ... \\
& + (2*S.*Y.*Z*(S_v3))/\exp(2*Z) + (S^2.*Y.*Z*(S_v3))/\exp(2*Z) + (S.*Y.^2*Z*(S_v3))/\exp(3*Z) + \\
& (3*S.*Y.^2*Z*(S_v3))/(2*\exp(2*Z)) + (S^2.*Y.^2*Z*(S_v3))/\exp(3*Z) ... \\
& + \frac{(S^2.*Y.^2*Z*(S_v3))}{(2*\exp(2*Z))} - \frac{(2*S.*Y.^3*Z*(S_v3))}{\exp(2*Z)} - \\
& (S^2.*Y.^3*Z*(S_v3))/\exp(2*Z) + (3*S.*Y.^4*Z*(S_v3))/(4*\exp(4*Z)) - (S.*Y.^4*Z*(S_v3))/\exp(3*Z) \\
& ... \\
& + \frac{(S.*Y.^4*Z*(S_v3))}{(4*\exp(2*Z))} + \frac{(3*S^2.*Y.^4*Z*(S_v3))}{(4*\exp(4*Z))} - \\
& (S^2.*Y.^4*Z*(S_v3))/\exp(3*Z) + (S^2.*Y.^4*Z*(S_v3))/(4*\exp(2*Z)) + (S^2.*Z^2*(S_v3))/(2*\exp(3*Z)) \\
& ... \\
& + \frac{(S^2.*Z^2*(S_v3))}{(2*\exp(3*Z))} - \frac{(S.*Y.^2*Z^2*(S_v3))}{\exp(3*Z)} - \\
& (S^2.*Y.^2*Z^2*(S_v3))/\exp(3*Z) + (S.*Y.^4*Z^2*(S_v3))/(2*\exp(3*Z)) ... \\
& + \frac{(S^2.*Y.^4*Z^2*(S_v3))}{(2*\exp(3*Z))} + \frac{(9*S^2*(S_v3)^2)}{(16*\exp(6*Z))} - \\
& (23*S^2*(S_v3)^2)/(8*\exp(4*Z)) + (2*S^2*(S_v3)^2)/\exp(3*Z) + (S^2*(S_v3)^2)/(16*\exp(2*Z)) ... \\
& - (\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/2 - \exp(-3*Z - Y.*Z)*S^2*(S_v3)^2 - \\
& (2*S^2.*Y.*(S_v3)^2)/\exp(3*Z) - (S^2.*Y.*(S_v3)^2)/\exp(2*Z) + (9*S^2.*Y.^2*(S_v3)^2)/(8*\exp(6*Z)) \\
& ... \\
& - \frac{(3*S^2.*Y.^2*(S_v3)^2)}{(2*\exp(5*Z))} + \frac{(11*S^2.*Y.^2*(S_v3)^2)}{(2*\exp(4*Z))} - \\
& (7*S^2.*Y.^2*(S_v3)^2)/(2*\exp(3*Z)) + (15*S^2.*Y.^2*(S_v3)^2)/(8*\exp(2*Z)) ... \\
& + (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v3)^2)/2 + \exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v3)^2 - \\
& (3*S^2.*Y.^3*(S_v3)^2)/\exp(4*Z) + (4*S^2.*Y.^3*(S_v3)^2)/\exp(3*Z) ... \\
& - \frac{(S^2.*Y.^3*(S_v3)^2)}{\exp(2*Z)} + \frac{(9*S^2.*Y.^4*(S_v3)^2)}{(16*\exp(6*Z))} - \\
& (3*S^2.*Y.^4*(S_v3)^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^4*(S_v3)^2)/(8*\exp(4*Z)) ... \\
& - \frac{(S^2.*Y.^4*(S_v3)^2)}{(2*\exp(3*Z))} + \frac{(S^2.*Y.^4*(S_v3)^2)}{(16*\exp(2*Z))} + \\
& (9*S^2*(S_v3)^2)/(4*\exp(6*Z)*Z^4) - (6*S^2*(S_v3)^2)/(\exp(5*Z)*Z^4) ... \\
& + \frac{(11*S^2*(S_v3)^2)}{(2*\exp(4*Z)*Z^4)} - \frac{(2*S^2*(S_v3)^2)}{(\exp(3*Z)*Z^4)} + \\
& (S^2*(S_v3)^2)/(4*\exp(2*Z)*Z^4) + (S^2*(S_v3)^2)/(4*\exp(2.*Y.*Z)*Z^4) ... \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/(2*Z^4) ... \\
& - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_v3)^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S^2*(S_v3)^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_v3)^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S^2*(S_v3)^2)/Z^4 ... \\
& + (4*\exp(-2*Z - Y.*Z)*S^2*(S_v3)^2)/Z^4 - (\exp(-Z - Y.*Z)*S^2*(S_v3)^2)/(2*Z^4) + \\
& (12*S^2*(S_v3)^2)/(\exp(5*Z)*Z^3) - (22*S^2*(S_v3)^2)/(\exp(4*Z)*Z^3) ... \\
& + \frac{(27*S^2*(S_v3)^2)}{(2*\exp(3*Z)*Z^3)} - \frac{(4*S^2*(S_v3)^2)}{(\exp(2*Z)*Z^3)} + \\
& (S^2*(S_v3)^2)/(2*\exp(Z)*Z^3) - (S^2*(S_v3)^2)/(2*\exp(3.*Y.*Z)*Z^3) ... \\
& - (S^2*(S_v3)^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S^2*(S_v3)^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_v3)^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/(2*Z^3) ... \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v3)^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v3)^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_v3)^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_v3)^2)/Z^3 ... \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_v3)^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_v3)^2)/Z^3 - \\
& (9*S^2.*Y.*(S_v3)^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_v3)^2)/(\exp(4*Z)*Z^3) ... \\
& - \frac{(11*S^2.*Y.*(S_v3)^2)}{(\exp(3*Z)*Z^3)} + \frac{(4*S^2.*Y.*(S_v3)^2)}{(\exp(2*Z)*Z^3)} - \\
& (S^2.*Y.*(S_v3)^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_v3)^2)/(2*\exp(Y.*Z)*Z^3) ... \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_v3)^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_v3)^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v3)^2)/Z^3 ... \\
& - \frac{(4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v3)^2)}{Z^3} + \frac{(S^2*(S_v3)^2)}{(4*Z^2)} + \\
& (9*S^2*(S_v3)^2)/(4*\exp(6*Z)*Z^2) - \frac{(3*S^2*(S_v3)^2)}{(\exp(5*Z)*Z^2)} + \\
& (19*S^2*(S_v3)^2)/(\exp(4*Z)*Z^2) ...
\end{aligned}$$

$$\begin{aligned}
& - (19*S^2*(S_{v3})^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_{v3})^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_{v3})^2)/(\exp(Z)*Z^2) + (S^2*(S_{v3})^2)/(4*\exp(4*Y.*Z)*Z^2) \dots \\
& + (S^2*(S_{v3})^2)/(2*\exp(2*Y.*Z)*Z^2) + (\exp(-Z - 3*Y.*Z)*S^2*(S_{v3})^2)/Z^2 + (5*\exp(-2*Z - \\
& 2*Y.*Z)*S^2*(S_{v3})^2)/Z^2 - (2*\exp(-Z - 2*Y.*Z)*S^2*(S_{v3})^2)/Z^2 \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v3})^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v3})^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S^2*(S_{v3})^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_{v3})^2)/Z^2 \dots \\
& + (\exp(-Z - Y.*Z)*S^2*(S_{v3})^2)/(4*Z^2) - (S^2.*Y.*(S_{v3})^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_{v3})^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_{v3})^2)/(\exp(3*Z)*Z^2) \dots \\
& - (29*S^2.*Y.*(S_{v3})^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_{v3})^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_{v3})^2)/(2*\exp(2*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2*Y.*Z)*S^2.*Y.*(S_{v3})^2)/(2*Z^2) \dots \\
& + (2*\exp(-Z - 2*Y.*Z)*S^2.*Y.*(S_{v3})^2)/Z^2 + (S^2.*Y.^2*(S_{v3})^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_{v3})^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_{v3})^2)/(\exp(5*Z)*Z^2) \dots \\
& + (31*S^2.*Y.^2*(S_{v3})^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_{v3})^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_{v3})^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_{v3})^2)/(\exp(Z)*Z^2) \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/(2*Z^2) \dots \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v3})^2)/(2*\exp(5*Z)*Z) - (S^2*(S_{v3})^2)/(\exp(4*Z)*Z) \dots \\
& + (25*S^2*(S_{v3})^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_{v3})^2)/(\exp(2*Z)*Z) + \\
& (3*S^2*(S_{v3})^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2*Y.*Z)*S^2*(S_{v3})^2)/(4*Z) \dots \\
& + (3*\exp(-Z - 2*Y.*Z)*S^2*(S_{v3})^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v3})^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_{v3})^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_{v3})^2)/Z \dots \\
& - (9*S^2.*Y.*(S_{v3})^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_{v3})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_{v3})^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_{v3})^2)/(\exp(2*Z)*Z) \dots \\
& - (7*S^2.*Y.*(S_{v3})^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2*Y.*Z)*S^2.*Y.*(S_{v3})^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_{v3})^2)/Z + (15*S^2.*Y.^2*(S_{v3})^2)/(2*\exp(5*Z)*Z) \dots \\
& - (13*S^2.*Y.^2*(S_{v3})^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_{v3})^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_{v3})^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_{v3})^2)/(4*\exp(Z)*Z) \dots \\
& + (3*\exp(-3*Z - 2*Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/(4*Z) - (\exp(-2*Z - 2*Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/Z \\
& + (\exp(-Z - 2*Y.*Z)*S^2.*Y.^2*(S_{v3})^2)/(4*Z) \dots \\
& - (9*S^2.*Y.^3*(S_{v3})^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_{v3})^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_{v3})^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_{v3})^2)/(\exp(2*Z)*Z) \dots \\
& - (S^2.*Y.^3*(S_{v3})^2)/(4*\exp(Z)*Z) - (3*S^2*Z*(S_{v3})^2)/(4*\exp(5*Z)) - \\
& (3*S^2*Z*(S_{v3})^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_{v3})^2)/\exp(3*Z) + \\
& (S^2.*Y.^2*Z*(S_{v3})^2)/\exp(4*Z) \dots \\
& + (S^2.*Y.^2*Z*(S_{v3})^2)/(2*\exp(3*Z)) - (S^2.*Y.^3*Z*(S_{v3})^2)/\exp(3*Z) + \\
& (3*S^2.*Y.^4*Z*(S_{v3})^2)/(4*\exp(5*Z)) - (S^2.*Y.^4*Z*(S_{v3})^2)/\exp(4*Z) \dots \\
& + (S^2.*Y.^4*Z*(S_{v3})^2)/(4*\exp(3*Z)) + (S^2*Z^2*(S_{v3})^2)/(4*\exp(4*Z)) - \\
& (S^2.*Y.^2*Z^2*(S_{v3})^2)/(2*\exp(4*Z)) + (S^2.*Y.^4*Z^2*(S_{v3})^2)/(4*\exp(4*Z));
\end{aligned}$$

Ns3=Nf+Nc+Ny3;
Phi3=Nf./[Nc+Ny3];
Be3=1./[1+Phi3];
Gf3=Nf./Ns3;
Gh3=[Nc+Ny3]./Ns3;
Nh3=Nc+Ny3;

S_v4=4;
Ny4=1 - exp(-2*Z) + exp(-Z - Y.*Z) - (2*S)/exp(2*Z) + 2*exp(-Z - Y.*Z)*S - S^2/exp(2*Z) + exp(-Z - Y.*Z)*S^2 - 2*Y + Y.^2 + Y.^2/exp(2*Z) - exp(-Z - Y.*Z)*Y.^2 ...
+ (2*S.*Y.^2)/exp(2*Z) - 2*exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/exp(2*Z) - exp(-Z - Y.*Z)*S^2.*Y.^2 + 1/(exp(2*Z)*Z^2) + 1/(exp(2*Y.*Z)*Z^2) ...
- (2*exp(-Z - Y.*Z))/Z^2 + (2*S)/(exp(2*Z)*Z^2) + (2*S)/(exp(2*Y.*Z)*Z^2) - (4*exp(-Z - Y.*Z)*S)/Z^2 + S^2/(exp(2*Z)*Z^2) + S^2/(exp(2*Y.*Z)*Z^2) ...

$$\begin{aligned}
& - (2*\exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(\exp(Z)*Z) - 2/(\exp(Y.*Z)*Z) + (2*S)/(\exp(Z)*Z) - \\
& (2*S)/(\exp(Y.*Z)*Z) - (2.*Y)/(\exp(Z)*Z) + (2.*Y)/(\exp(Y.*Z)*Z) \dots \\
& - (2*S.*Y)/(\exp(Z)*Z) + (2*S.*Y)/(\exp(Y.*Z)*Z) - Z/\exp(Z) - (S*Z)/\exp(Z) + (Y.*Z)/\exp(Z) + \\
& (S.*Y.*Z)/\exp(Z) + (Y.^2*Z)/\exp(Z) + (S.*Y.^2*Z)/\exp(Z) - (Y.^3*Z)/\exp(Z) \dots \\
& - (S.*Y.^3*Z)/\exp(Z) + Z^2/(4*\exp(2*Z)) + (S*Z^2)/(2*\exp(2*Z)) + (S^2*Z^2)/(4*\exp(2*Z)) - \\
& (Y.^2*Z^2)/(2*\exp(2*Z)) - (S.*Y.^2*Z^2)/\exp(2*Z) \dots \\
& - (S^2.*Y.^2*Z^2)/(2*\exp(2*Z)) + (Y.^4*Z^2)/(4*\exp(2*Z)) + (S.*Y.^4*Z^2)/(2*\exp(2*Z)) + \\
& (S^2.*Y.^4*Z^2)/(4*\exp(2*Z)) - (7*S*(S_v4))/(2*\exp(3*Z)) \dots \\
& + (2*S*(S_v4))/\exp(2*Z) + (S*(S_v4))/\exp(Z) - (\exp(-Z - 2.*Y.*Z)*S*(S_v4))/2 - \\
& (5*S^2*(S_v4))/\exp(3*Z) + (2*S^2*(S_v4))/\exp(2*Z) - (S^2*(S_v4))/(2*\exp(Z)) \dots \\
& - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v4))/2 - (2*S.*Y.*(S_v4))/\exp(2*Z) - (3*S.*Y.*(S_v4))/\exp(Z) + \\
& (3*S^2.*Y.*(S_v4))/(2*\exp(3*Z)) - (2*S^2.*Y.*(S_v4))/\exp(2*Z) \dots \\
& + (S^2.*Y.*(S_v4))/(2*\exp(Z)) + (13*S.*Y.^2*(S_v4))/(2*\exp(3*Z)) - (4*S.*Y.^2*(S_v4))/\exp(2*Z) + \\
& (3*S.*Y.^2*(S_v4))/\exp(Z) + (\exp(-Z - 2.*Y.*Z)*S.*Y.^2*(S_v4))/2 \dots \\
& + (5*S^2.*Y.^2*(S_v4))/\exp(3*Z) - (2*S^2.*Y.^2*(S_v4))/\exp(2*Z) + (S^2.*Y.^2*(S_v4))/(2*\exp(Z)) \\
& + (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v4))/2 - (3*S.*Y.^3*(S_v4))/\exp(3*Z) \dots \\
& + (4*S.*Y.^3*(S_v4))/\exp(2*Z) - (S.*Y.^3*(S_v4))/\exp(Z) - (3*S^2.*Y.^3*(S_v4))/(2*\exp(3*Z)) + \\
& (2*S^2.*Y.^3*(S_v4))/\exp(2*Z) - (S^2.*Y.^3*(S_v4))/(2*\exp(Z)) \dots \\
& + (3*S*(S_v4))/(\exp(4*Z)*Z^3) - (4*S*(S_v4))/(\exp(3*Z)*Z^3) + (S*(S_v4))/(\exp(2*Z)*Z^3) + \\
& (S*(S_v4))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S*(S_v4))/Z^3 \dots \\
& - (4*\exp(-Z - 2.*Y.*Z)*S*(S_v4))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S*(S_v4))/Z^3 + (8*\exp(-2*Z - \\
& Y.*Z)*S*(S_v4))/Z^3 - (2*\exp(-Z - Y.*Z)*S*(S_v4))/Z^3 \dots \\
& + (3*S^2*(S_v4))/(\exp(4*Z)*Z^3) - (4*S^2*(S_v4))/(\exp(3*Z)*Z^3) + (S^2*(S_v4))/(\exp(2*Z)*Z^3) + \\
& (S^2*(S_v4))/(\exp(2.*Y.*Z)*Z^3) + (3*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_v4))/Z^3 \dots \\
& - (4*\exp(-Z - 2.*Y.*Z)*S^2*(S_v4))/Z^3 - (6*\exp(-3*Z - Y.*Z)*S^2*(S_v4))/Z^3 + (8*\exp(-2*Z - \\
& Y.*Z)*S^2*(S_v4))/Z^3 - (2*\exp(-Z - Y.*Z)*S^2*(S_v4))/Z^3 \dots \\
& + (11*S*(S_v4))/(\exp(3*Z)*Z^2) - (8*S*(S_v4))/(\exp(2*Z)*Z^2) + (2*S*(S_v4))/(\exp(Z)*Z^2) - \\
& (S*(S_v4))/(\exp(3.*Y.*Z)*Z^2) - (2*S*(S_v4))/(\exp(Y.*Z)*Z^2) \dots \\
& - (\exp(-Z - 2.*Y.*Z)*S*(S_v4))/Z^2 - (9*\exp(-2*Z - Y.*Z)*S*(S_v4))/Z^2 + (8*\exp(-Z - \\
& Y.*Z)*S*(S_v4))/Z^2 + (8*S^2*(S_v4))/(\exp(3*Z)*Z^2); \dots \\
& - (4*S^2*(S_v4))/(\exp(2*Z)*Z^2) + (S^2*(S_v4))/(\exp(Z)*Z^2) - (S^2*(S_v4))/(\exp(3.*Y.*Z)*Z^2) - \\
& (S^2*(S_v4))/(\exp(Y.*Z)*Z^2) - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v4))/Z^2 \dots \\
& - (6*\exp(-2*Z - Y.*Z)*S^2*(S_v4))/Z^2 + (4*\exp(-Z - Y.*Z)*S^2*(S_v4))/Z^2 - \\
& (6*S.*Y.*(S_v4))/(\exp(3*Z)*Z^2) + (8*S.*Y.*(S_v4))/(\exp(2*Z)*Z^2) \dots \\
& - (2*S.*Y.*(S_v4))/(\exp(Z)*Z^2) + (2*S.*Y.*(S_v4))/(\exp(Y.*Z)*Z^2) + (6*\exp(-2*Z - \\
& Y.*Z)*S.*Y.*(S_v4))/Z^2 - (8*\exp(-Z - Y.*Z)*S.*Y.*(S_v4))/Z^2 \dots \\
& - (3*S^2.*Y.*(S_v4))/(\exp(3*Z)*Z^2) + (4*S^2.*Y.*(S_v4))/(\exp(2*Z)*Z^2) - \\
& (S^2.*Y.*(S_v4))/(\exp(Z)*Z^2) + (S^2.*Y.*(S_v4))/(\exp(Y.*Z)*Z^2) \dots \\
& + (3*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v4))/Z^2 - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v4))/Z^2 + (S*(S_v4))/Z \\
& + (2*S*(S_v4))/(\exp(3*Z)*Z) + (9*S*(S_v4))/(\exp(2*Z)*Z) \dots \\
& - (4*S*(S_v4))/(\exp(Z)*Z) + (S*(S_v4))/(\exp(2.*Y.*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S*(S_v4))/Z + \\
& (\exp(-Z - Y.*Z)*S*(S_v4))/Z + (2*S^2*(S_v4))/(\exp(3*Z)*Z) \dots \\
& + (S^2*(S_v4))/(\exp(2*Z)*Z) - (2*\exp(-2*Z - Y.*Z)*S^2*(S_v4))/Z - (\exp(-Z - Y.*Z)*S^2*(S_v4))/Z - \\
& (2*S.*Y.*(S_v4))/Z - (13*S.*Y.*(S_v4))/(\exp(2*Z)*Z) \dots \\
& + (8*S.*Y.*(S_v4))/(\exp(Z)*Z) - (S.*Y.*(S_v4))/(\exp(2.*Y.*Z)*Z) - \\
& (2*S^2.*Y.*(S_v4))/(\exp(2*Z)*Z) + (2*\exp(-Z - Y.*Z)*S^2.*Y.*(S_v4))/Z + (S.*Y.^2*(S_v4))/Z \dots \\
& + (3*S.*Y.^2*(S_v4))/(\exp(4*Z)*Z) - (4*S.*Y.^2*(S_v4))/(\exp(3*Z)*Z) + \\
& (4*S.*Y.^2*(S_v4))/(\exp(2*Z)*Z) - (4*S.*Y.^2*(S_v4))/(\exp(Z)*Z) \dots \\
& - (3*\exp(-3*Z - Y.*Z)*S.*Y.^2*(S_v4))/Z + (4*\exp(-2*Z - Y.*Z)*S.*Y.^2*(S_v4))/Z - (\exp(-Z - \\
& Y.*Z)*S.*Y.^2*(S_v4))/Z + (3*S^2.*Y.^2*(S_v4))/(\exp(4*Z)*Z) \dots \\
& - (4*S^2.*Y.^2*(S_v4))/(\exp(3*Z)*Z) + (S^2.*Y.^2*(S_v4))/(\exp(2*Z)*Z) - (3*\exp(-3*Z - \\
& Y.*Z)*S^2.*Y.^2*(S_v4))/Z + (4*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v4))/Z \dots \\
& - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v4))/Z - (3*S*Z*(S_v4))/(4*\exp(4*Z)) - (7*S*Z*(S_v4))/(4*\exp(2*Z)) \\
& - (3*S^2*Z*(S_v4))/(4*\exp(4*Z)) - (3*S^2*Z*(S_v4))/(4*\exp(2*Z)) \dots \\
& + (2*S.*Y.*Z*(S_v4))/\exp(2*Z) + (S^2.*Y.*Z*(S_v4))/\exp(2*Z) + (S.*Y.^2*Z*(S_v4))/\exp(3*Z) + \\
& (3*S.*Y.^2*Z*(S_v4))/(2*\exp(2*Z)) + (S^2.*Y.^2*Z*(S_v4))/\exp(3*Z) \dots
\end{aligned}$$

$$\begin{aligned}
& + \frac{(S^2 * Y.^2 * Z * (S_v4))}{(2 * \exp(2 * Z))} - \frac{(2 * S * Y.^3 * Z * (S_v4))}{\exp(2 * Z)} - \\
& (S^2 * Y.^3 * Z * (S_v4)) / \exp(2 * Z) + (3 * S * Y.^4 * Z * (S_v4)) / (4 * \exp(4 * Z)) - (S * Y.^4 * Z * (S_v4)) / \exp(3 * Z) \\
& \dots \\
& + \frac{(S * Y.^4 * Z * (S_v4))}{(4 * \exp(2 * Z))} + \frac{(3 * S^2 * Y.^4 * Z * (S_v4))}{(4 * \exp(4 * Z))} - \\
& (S^2 * Y.^4 * Z * (S_v4)) / \exp(3 * Z) + (S^2 * Y.^4 * Z * (S_v4)) / (4 * \exp(2 * Z)) + (S * Z^2 * (S_v4)) / (2 * \exp(3 * Z)) \\
& \dots \\
& + \frac{(S^2 * Z^2 * (S_v4))}{(2 * \exp(3 * Z))} - \frac{(S * Y.^2 * Z^2 * (S_v4))}{\exp(3 * Z)} - \\
& (S^2 * Y.^2 * Z^2 * (S_v4)) / \exp(3 * Z) + (S * Y.^4 * Z^2 * (S_v4)) / (2 * \exp(3 * Z)) \dots \\
& + \frac{(S^2 * Y.^4 * Z^2 * (S_v4))}{(2 * \exp(3 * Z))} + \frac{(9 * S^2 * (S_v4)^2)}{(16 * \exp(6 * Z))} - \\
& (23 * S^2 * (S_v4)^2) / (8 * \exp(4 * Z)) + (2 * S^2 * (S_v4)^2) / \exp(3 * Z) + (S^2 * (S_v4)^2) / (16 * \exp(2 * Z)) \dots \\
& - \frac{(\exp(-2 * Z) - 2 * Y * Z * S^2 * (S_v4)^2)}{2} - \frac{\exp(-3 * Z - Y * Z) * S^2 * (S_v4)^2}{2} - \\
& (2 * S^2 * Y * (S_v4)^2) / \exp(3 * Z) - (S^2 * Y * (S_v4)^2) / \exp(2 * Z) + (9 * S^2 * Y.^2 * (S_v4)^2) / (8 * \exp(6 * Z)) \\
& \dots \\
& - \frac{(3 * S^2 * Y.^2 * (S_v4)^2)}{(2 * \exp(5 * Z))} + \frac{(11 * S^2 * Y.^2 * (S_v4)^2)}{(2 * \exp(4 * Z))} - \\
& (7 * S^2 * Y.^2 * (S_v4)^2) / (2 * \exp(3 * Z)) + (15 * S^2 * Y.^2 * (S_v4)^2) / (8 * \exp(2 * Z)) \dots \\
& + \frac{(\exp(-2 * Z - 2 * Y * Z) * S^2 * Y.^2 * (S_v4)^2)}{2} + \frac{\exp(-3 * Z - Y * Z) * S^2 * Y.^2 * (S_v4)^2}{2} - \\
& (3 * S^2 * Y.^3 * (S_v4)^2) / \exp(4 * Z) + (4 * S^2 * Y.^3 * (S_v4)^2) / \exp(3 * Z) \dots \\
& - \frac{(S^2 * Y.^3 * (S_v4)^2)}{\exp(2 * Z)} + \frac{(9 * S^2 * Y.^4 * (S_v4)^2)}{(16 * \exp(6 * Z))} - \\
& (3 * S^2 * Y.^4 * (S_v4)^2) / (2 * \exp(5 * Z)) + (11 * S^2 * Y.^4 * (S_v4)^2) / (8 * \exp(4 * Z)) \dots \\
& - \frac{(S^2 * Y.^4 * (S_v4)^2)}{(2 * \exp(3 * Z))} + \frac{(S^2 * Y.^4 * (S_v4)^2)}{(16 * \exp(2 * Z))} + \\
& (9 * S^2 * (S_v4)^2) / (4 * \exp(6 * Z) * Z^4) - (6 * S^2 * (S_v4)^2) / (\exp(5 * Z) * Z^4) \dots \\
& + \frac{(11 * S^2 * (S_v4)^2)}{(2 * \exp(4 * Z) * Z^4)} - \frac{(2 * S^2 * (S_v4)^2)}{(\exp(3 * Z) * Z^4)} + \\
& (S^2 * (S_v4)^2) / (4 * \exp(2 * Z) * Z^4) + (S^2 * (S_v4)^2) / (4 * \exp(2 * Y * Z) * Z^4) \dots \\
& + \frac{(9 * \exp(-4 * Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{(4 * Z^4)} - \frac{(6 * \exp(-3 * Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{Z^4} + \\
& (11 * \exp(-2 * Z - 2 * Y * Z) * S^2 * (S_v4)^2) / (2 * Z^4) \dots \\
& - \frac{(2 * \exp(-Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{Z^4} - \frac{(9 * \exp(-5 * Z - Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^4)} + \frac{(12 * \exp(-4 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^4} - \\
& \frac{(11 * \exp(-3 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^4} \dots \\
& + \frac{(4 * \exp(-2 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^4} - \frac{(\exp(-Z - Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^4)} + \\
& (12 * S^2 * (S_v4)^2) / (\exp(5 * Z) * Z^3) - (22 * S^2 * (S_v4)^2) / (\exp(4 * Z) * Z^3) \dots \\
& + \frac{(27 * S^2 * (S_v4)^2)}{(2 * \exp(3 * Z) * Z^3)} - \frac{(4 * S^2 * (S_v4)^2)}{(\exp(2 * Z) * Z^3)} + \\
& (S^2 * (S_v4)^2) / (2 * \exp(Z) * Z^3) - (S^2 * (S_v4)^2) / (2 * \exp(3 * Y * Z) * Z^3) \dots \\
& - \frac{(S^2 * (S_v4)^2)}{(2 * \exp(Y * Z) * Z^3)} - \frac{(3 * \exp(-2 * Z - 3 * Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^3)} + \frac{(2 * \exp(-Z - 3 * Y * Z) * S^2 * (S_v4)^2)}{Z^3} - \\
& \frac{(3 * \exp(-3 * Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^3)} \dots \\
& + \frac{(2 * \exp(-2 * Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{Z^3} - \frac{(\exp(-Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^3)} - \frac{(9 * \exp(-4 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^3} + \\
& \frac{(18 * \exp(-3 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^3} \dots \\
& - \frac{(25 * \exp(-2 * Z - Y * Z) * S^2 * (S_v4)^2)}{(2 * Z^3)} + \frac{(4 * \exp(-Z - Y * Z) * S^2 * (S_v4)^2)}{Z^3} - \\
& (9 * S^2 * Y * (S_v4)^2) / (2 * \exp(5 * Z) * Z^3) + (12 * S^2 * Y * (S_v4)^2) / (\exp(4 * Z) * Z^3) \dots \\
& - \frac{(11 * S^2 * Y * (S_v4)^2)}{(\exp(3 * Z) * Z^3)} + \frac{(4 * S^2 * Y * (S_v4)^2)}{(\exp(2 * Z) * Z^3)} - \\
& (S^2 * Y * (S_v4)^2) / (2 * \exp(Z) * Z^3) + (S^2 * Y * (S_v4)^2) / (2 * \exp(Y * Z) * Z^3) \dots \\
& + \frac{(9 * \exp(-4 * Z - Y * Z) * S^2 * Y * (S_v4)^2)}{(2 * Z^3)} - \frac{(12 * \exp(-3 * Z - Y * Z) * S^2 * Y * (S_v4)^2)}{Z^3} + \\
& (11 * \exp(-2 * Z - Y * Z) * S^2 * Y * (S_v4)^2) / Z^3 \dots \\
& - \frac{(4 * \exp(-Z - Y * Z) * S^2 * Y * (S_v4)^2)}{Z^3} + \frac{(S^2 * (S_v4)^2)}{(4 * Z^2)} + \\
& (9 * S^2 * (S_v4)^2) / (4 * \exp(6 * Z) * Z^2) - \frac{(3 * S^2 * (S_v4)^2)}{(\exp(5 * Z) * Z^2)} + \\
& (19 * S^2 * (S_v4)^2) / (\exp(4 * Z) * Z^2) \dots \\
& - \frac{(19 * S^2 * (S_v4)^2)}{(\exp(3 * Z) * Z^2)} + \frac{(35 * S^2 * (S_v4)^2)}{(4 * \exp(2 * Z) * Z^2)} - \\
& (2 * S^2 * (S_v4)^2) / (\exp(Z) * Z^2) + (S^2 * (S_v4)^2) / (4 * \exp(4 * Y * Z) * Z^2) \dots \\
& + \frac{(S^2 * (S_v4)^2)}{(2 * \exp(2 * Y * Z) * Z^2)} + \frac{(\exp(-Z - 3 * Y * Z) * S^2 * (S_v4)^2)}{Z^2} + \frac{(5 * \exp(-2 * Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{Z^2} - \\
& \frac{(2 * \exp(-Z - 2 * Y * Z) * S^2 * (S_v4)^2)}{Z^2} \dots \\
& - \frac{(9 * \exp(-5 * Z - Y * Z) * S^2 * (S_v4)^2)}{(4 * Z^2)} + \frac{(3 * \exp(-4 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^2} + \frac{(5 * \exp(-3 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^2} - \\
& \frac{(\exp(-2 * Z - Y * Z) * S^2 * (S_v4)^2)}{Z^2} \dots \\
& + \frac{(\exp(-Z - Y * Z) * S^2 * (S_v4)^2)}{(4 * Z^2)} - \frac{(S^2 * Y * (S_v4)^2)}{(2 * Z^2)} - \\
& (15 * S^2 * Y * (S_v4)^2) / (\exp(4 * Z) * Z^2) + (26 * S^2 * Y * (S_v4)^2) / (\exp(3 * Z) * Z^2) \dots \\
& - \frac{(29 * S^2 * Y * (S_v4)^2)}{(2 * \exp(2 * Z) * Z^2)} + \frac{(4 * S^2 * Y * (S_v4)^2)}{(\exp(Z) * Z^2)} - \\
& (S^2 * Y * (S_v4)^2) / (2 * \exp(2 * Y * Z) * Z^2) - \frac{(3 * \exp(-2 * Z - 2 * Y * Z) * S^2 * Y * (S_v4)^2)}{(2 * Z^2)} \dots \\
& + \frac{(2 * \exp(-Z - 2 * Y * Z) * S^2 * Y * (S_v4)^2)}{Z^2} + \frac{(S^2 * Y.^2 * (S_v4)^2)}{(4 * Z^2)} + \\
& (9 * S^2 * Y.^2 * (S_v4)^2) / (4 * \exp(6 * Z) * Z^2) - \frac{(6 * S^2 * Y.^2 * (S_v4)^2)}{(\exp(5 * Z) * Z^2)} \dots
\end{aligned}$$

$$\begin{aligned}
& + (31*S^2.*Y.^2*(S_v4)^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_v4)^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_v4)^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_v4)^2)/(\exp(Z)*Z^2) \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_v4)^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_v4)^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_v4)^2)/(2*Z^2) \dots \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_v4)^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_v4)^2)/(4*Z^2) + \\
& (9*S^2*(S_v4)^2)/(2*\exp(5*Z)*Z) - (S^2*(S_v4)^2)/(\exp(4*Z)*Z) \dots \\
& + (25*S^2*(S_v4)^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_v4)^2)/(\exp(2*Z)*Z) + \\
& (3*S^2*(S_v4)^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_v4)^2)/(4*Z) \dots \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_v4)^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_v4)^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_v4)^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_v4)^2)/Z \dots \\
& - (9*S^2.*Y.*(S_v4)^2)/(4*\exp(5*Z)*Z) + (3*S^2.*Y.*(S_v4)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.*(S_v4)^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_v4)^2)/(\exp(2*Z)*Z) \dots \\
& - (7*S^2.*Y.*(S_v4)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v4)^2)/Z - (2*\exp(-2*Z - \\
& Y.*Z)*S^2.*Y.*(S_v4)^2)/Z + (15*S^2.*Y.^2*(S_v4)^2)/(2*\exp(5*Z)*Z) \dots \\
& - (13*S^2.*Y.^2*(S_v4)^2)/(\exp(4*Z)*Z) + (41*S^2.*Y.^2*(S_v4)^2)/(4*\exp(3*Z)*Z) - \\
& (6*S^2.*Y.^2*(S_v4)^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_v4)^2)/(4*\exp(Z)*Z) \dots \\
& + (3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v4)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v4)^2)/Z \\
& + (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v4)^2)/(4*Z) \dots \\
& - (9*S^2.*Y.^3*(S_v4)^2)/(4*\exp(5*Z)*Z) + (6*S^2.*Y.^3*(S_v4)^2)/(\exp(4*Z)*Z) - \\
& (11*S^2.*Y.^3*(S_v4)^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_v4)^2)/(\exp(2*Z)*Z) \dots \\
& - (S^2.*Y.^3*(S_v4)^2)/(4*\exp(Z)*Z) - (3*S^2*Z*(S_v4)^2)/(4*\exp(5*Z)) - \\
& (3*S^2*Z*(S_v4)^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_v4)^2)/\exp(3*Z) + \\
& (S^2.*Y.^2*Z*(S_v4)^2)/\exp(4*Z) \dots \\
& + (S^2.*Y.^2*Z*(S_v4)^2)/(2*\exp(3*Z)) - (S^2.*Y.^3*Z*(S_v4)^2)/\exp(3*Z) + \\
& (3*S^2.*Y.^4*Z*(S_v4)^2)/(4*\exp(5*Z)) - (S^2.*Y.^4*Z*(S_v4)^2)/\exp(4*Z) \dots \\
& + (S^2.*Y.^4*Z*(S_v4)^2)/(4*\exp(3*Z)) + (S^2*Z^2*(S_v4)^2)/(4*\exp(4*Z)) - \\
& (S^2.*Y.^2*Z^2*(S_v4)^2)/(2*\exp(4*Z)) + (S^2.*Y.^4*Z^2*(S_v4)^2)/(4*\exp(4*Z));
\end{aligned}$$

$$\begin{aligned}
Ns4 &= Nf + Nc + Ny4; \\
Phi4 &= Nf./[Nc + Ny4]; \\
Be4 &= 1./[1 + Phi4]; \\
Gf4 &= Nf./Ns4; \\
Gh4 &= [Nc + Ny4]./Ns4; \\
Nh4 &= Nc + Ny4;
\end{aligned}$$

$$\begin{aligned}
S_v5 &= 5; \\
Ny5 &= 1 - \exp(-2*Z) + \exp(-Z - Y.*Z) - (2*S)/\exp(2*Z) + 2*\exp(-Z - Y.*Z)*S - S^2/\exp(2*Z) + \exp(-Z - \\
& Y.*Z)*S^2 - 2.*Y + Y.^2 + Y.^2/\exp(2*Z) - \exp(-Z - Y.*Z)*Y.^2 \dots \\
& + (2*S.*Y.^2)/\exp(2*Z) - 2*\exp(-Z - Y.*Z)*S.*Y.^2 + (S^2.*Y.^2)/\exp(2*Z) - \exp(-Z - \\
& Y.*Z)*S^2.*Y.^2 + 1/(\exp(2*Z)*Z^2) + 1./(\exp(2.*Y.*Z)*Z^2) \dots \\
& - (2*\exp(-Z - Y.*Z))/Z^2 + (2*S)/(\exp(2*Z)*Z^2) + (2*S)./(\exp(2.*Y.*Z)*Z^2) - (4*\exp(-Z - \\
& Y.*Z)*S)/Z^2 + S^2/(\exp(2*Z)*Z^2) + S^2./(\exp(2.*Y.*Z)*Z^2) \dots \\
& - (2*\exp(-Z - Y.*Z)*S^2)/Z^2 + 2/(\exp(Z)*Z) - 2./(\exp(Y.*Z)*Z) + (2*S)/(\exp(Z)*Z) - \\
& (2*S)./(\exp(Y.*Z)*Z) - (2.*Y)/(\exp(Z)*Z) + (2.*Y)/(\exp(Y.*Z)*Z) \dots \\
& - (2*S.*Y)/(\exp(Z)*Z) + (2*S.*Y)/(\exp(Y.*Z)*Z) - Z/\exp(Z) - (S*Z)/\exp(Z) + (Y.*Z)/\exp(Z) + \\
& (S.*Y.*Z)/\exp(Z) + (Y.^2*Z)/\exp(Z) + (S.*Y.^2*Z)/\exp(Z) - (Y.^3*Z)/\exp(Z) \dots \\
& - (S.*Y.^3*Z)/\exp(Z) + Z^2/(4*\exp(2*Z)) + (S*Z^2)/(2*\exp(2*Z)) + (S^2*Z^2)/(4*\exp(2*Z)) - \\
& (Y.^2*Z^2)/(2*\exp(2*Z)) - (S.*Y.^2*Z^2)/\exp(2*Z) \dots \\
& - (S^2.*Y.^2*Z^2)/(2*\exp(2*Z)) + (Y.^4*Z^2)/(4*\exp(2*Z)) + (S.*Y.^4*Z^2)/(2*\exp(2*Z)) + \\
& (S^2.*Y.^4*Z^2)/(4*\exp(2*Z)) - (7*S*(S_v5))/(2*\exp(3*Z)) \dots \\
& + (2*S*(S_v5))/\exp(2*Z) + (S*(S_v5))/\exp(Z) - (\exp(-Z - 2.*Y.*Z)*S*(S_v5))/2 - \\
& (5*S^2*(S_v5))/\exp(3*Z) + (2*S^2*(S_v5))/\exp(2*Z) - (S^2*(S_v5))/(2*\exp(Z)) \dots \\
& - (\exp(-Z - 2.*Y.*Z)*S^2*(S_v5))/2 - (2*S.*Y.*(S_v5))/\exp(2*Z) - (3*S.*Y.*(S_v5))/\exp(Z) + \\
& (3*S^2.*Y.*(S_v5))/(2*\exp(3*Z)) - (2*S^2.*Y.*(S_v5))/\exp(2*Z) \dots
\end{aligned}$$

$$\begin{aligned}
& + (S^2 * Y * (S_{v5})) / (2 * \exp(Z)) + (13 * S * Y^2 * (S_{v5})) / (2 * \exp(3 * Z)) - (4 * S * Y^2 * (S_{v5})) / \exp(2 * Z) + \\
& (3 * S * Y^2 * (S_{v5})) / \exp(Z) + (\exp(-Z - 2 * Y * Z) * S * Y^2 * (S_{v5})) / 2 \dots \\
& + (5 * S^2 * Y^2 * (S_{v5})) / \exp(3 * Z) - (2 * S^2 * Y^2 * (S_{v5})) / \exp(2 * Z) + (S^2 * Y^2 * (S_{v5})) / (2 * \exp(Z)) \\
& + (\exp(-Z - 2 * Y * Z) * S^2 * Y^2 * (S_{v5})) / 2 - (3 * S * Y^3 * (S_{v5})) / \exp(3 * Z) \dots \\
& + (4 * S * Y^3 * (S_{v5})) / \exp(2 * Z) - (S * Y^3 * (S_{v5})) / \exp(Z) - (3 * S^2 * Y^3 * (S_{v5})) / (2 * \exp(3 * Z)) + \\
& (2 * S^2 * Y^3 * (S_{v5})) / \exp(2 * Z) - (S^2 * Y^3 * (S_{v5})) / (2 * \exp(Z)) \dots \\
& + (3 * S * (S_{v5})) / (\exp(4 * Z) * Z^3) - (4 * S * (S_{v5})) / (\exp(3 * Z) * Z^3) + (S * (S_{v5})) / (\exp(2 * Z) * Z^3) + \\
& (S * (S_{v5})) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S * (S_{v5})) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S * (S_{v5})) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S * (S_{v5})) / Z^3 + (8 * \exp(-2 * Z - \\
& Y * Z) * S * (S_{v5})) / Z^3 - (2 * \exp(-Z - Y * Z) * S * (S_{v5})) / Z^3 \dots \\
& + (3 * S^2 * (S_{v5})) / (\exp(4 * Z) * Z^3) - (4 * S^2 * (S_{v5})) / (\exp(3 * Z) * Z^3) + (S^2 * (S_{v5})) / (\exp(2 * Z) * Z^3) + \\
& (S^2 * (S_{v5})) / (\exp(2 * Y * Z) * Z^3) + (3 * \exp(-2 * Z - 2 * Y * Z) * S^2 * (S_{v5})) / Z^3 \dots \\
& - (4 * \exp(-Z - 2 * Y * Z) * S^2 * (S_{v5})) / Z^3 - (6 * \exp(-3 * Z - Y * Z) * S^2 * (S_{v5})) / Z^3 + (8 * \exp(-2 * Z - \\
& Y * Z) * S^2 * (S_{v5})) / Z^3 - (2 * \exp(-Z - Y * Z) * S^2 * (S_{v5})) / Z^3 \dots \\
& + (11 * S * (S_{v5})) / (\exp(3 * Z) * Z^2) - (8 * S * (S_{v5})) / (\exp(2 * Z) * Z^2) + (2 * S * (S_{v5})) / (\exp(Z) * Z^2) - \\
& (S * (S_{v5})) / (\exp(3 * Y * Z) * Z^2) - (2 * S * (S_{v5})) / (\exp(Y * Z) * Z^2) \dots \\
& - (\exp(-Z - 2 * Y * Z) * S * (S_{v5})) / Z^2 - (9 * \exp(-2 * Z - Y * Z) * S * (S_{v5})) / Z^2 + (8 * \exp(-Z - \\
& Y * Z) * S * (S_{v5})) / Z^2 + (8 * S^2 * (S_{v5})) / (\exp(3 * Z) * Z^2); \dots \\
& - (4 * S^2 * (S_{v5})) / (\exp(2 * Z) * Z^2) + (S^2 * (S_{v5})) / (\exp(Z) * Z^2) - (S^2 * (S_{v5})) / (\exp(3 * Y * Z) * Z^2) - \\
& (S^2 * (S_{v5})) / (\exp(Y * Z) * Z^2) - (\exp(-Z - 2 * Y * Z) * S^2 * (S_{v5})) / Z^2 \dots \\
& - (6 * \exp(-2 * Z - Y * Z) * S^2 * (S_{v5})) / Z^2 + (4 * \exp(-Z - Y * Z) * S^2 * (S_{v5})) / Z^2 - \\
& (6 * S * Y * (S_{v5})) / (\exp(3 * Z) * Z^2) + (8 * S * Y * (S_{v5})) / (\exp(2 * Z) * Z^2) \dots \\
& - (2 * S * Y * (S_{v5})) / (\exp(Z) * Z^2) + (2 * S * Y * (S_{v5})) / (\exp(Y * Z) * Z^2) + (6 * \exp(-2 * Z - \\
& Y * Z) * S * Y * (S_{v5})) / Z^2 - (8 * \exp(-Z - Y * Z) * S * Y * (S_{v5})) / Z^2 \dots \\
& - (3 * S^2 * Y * (S_{v5})) / (\exp(3 * Z) * Z^2) + (4 * S^2 * Y * (S_{v5})) / (\exp(2 * Z) * Z^2) - \\
& (S^2 * Y * (S_{v5})) / (\exp(Z) * Z^2) + (S^2 * Y * (S_{v5})) / (\exp(Y * Z) * Z^2) \dots \\
& + (3 * \exp(-2 * Z - Y * Z) * S^2 * Y * (S_{v5})) / Z^2 - (4 * \exp(-Z - Y * Z) * S^2 * Y * (S_{v5})) / Z^2 + (S * (S_{v5})) / Z \\
& + (2 * S * (S_{v5})) / (\exp(3 * Z) * Z) + (9 * S * (S_{v5})) / (\exp(2 * Z) * Z) \dots \\
& - (4 * S * (S_{v5})) / (\exp(Z) * Z) + (S * (S_{v5})) / (\exp(2 * Y * Z) * Z) - (2 * \exp(-2 * Z - Y * Z) * S * (S_{v5})) / Z + \\
& (\exp(-Z - Y * Z) * S * (S_{v5})) / Z + (2 * S^2 * (S_{v5})) / (\exp(3 * Z) * Z) \dots \\
& + (S^2 * (S_{v5})) / (\exp(2 * Z) * Z) - (2 * \exp(-2 * Z - Y * Z) * S^2 * (S_{v5})) / Z - (\exp(-Z - Y * Z) * S^2 * (S_{v5})) / Z - \\
& (2 * S * Y * (S_{v5})) / Z - (13 * S * Y * (S_{v5})) / (\exp(2 * Z) * Z) \dots \\
& + (8 * S * Y * (S_{v5})) / (\exp(Z) * Z) - (S * Y * (S_{v5})) / (\exp(2 * Y * Z) * Z) - \\
& (2 * S^2 * Y * (S_{v5})) / (\exp(2 * Z) * Z) + (2 * \exp(-Z - Y * Z) * S^2 * Y * (S_{v5})) / Z + (S * Y^2 * (S_{v5})) / Z \dots \\
& + (3 * S * Y^2 * (S_{v5})) / (\exp(4 * Z) * Z) - (4 * S * Y^2 * (S_{v5})) / (\exp(3 * Z) * Z) + \\
& (4 * S * Y^2 * (S_{v5})) / (\exp(2 * Z) * Z) - (4 * S * Y^2 * (S_{v5})) / (\exp(Z) * Z) \dots \\
& - (3 * \exp(-3 * Z - Y * Z) * S * Y^2 * (S_{v5})) / Z + (4 * \exp(-2 * Z - Y * Z) * S * Y^2 * (S_{v5})) / Z - (\exp(-Z - \\
& Y * Z) * S * Y^2 * (S_{v5})) / Z + (3 * S^2 * Y^2 * (S_{v5})) / (\exp(4 * Z) * Z) \dots \\
& - (4 * S^2 * Y^2 * (S_{v5})) / (\exp(3 * Z) * Z) + (S^2 * Y^2 * (S_{v5})) / (\exp(2 * Z) * Z) - (3 * \exp(-3 * Z - \\
& Y * Z) * S^2 * Y^2 * (S_{v5})) / Z + (4 * \exp(-2 * Z - Y * Z) * S^2 * Y^2 * (S_{v5})) / Z \dots \\
& - (\exp(-Z - Y * Z) * S^2 * Y^2 * (S_{v5})) / Z - (3 * S^2 * Y^2 * (S_{v5})) / (4 * \exp(4 * Z)) - (7 * S * Z * (S_{v5})) / (4 * \exp(2 * Z)) \\
& - (3 * S^2 * Z * (S_{v5})) / (4 * \exp(4 * Z)) - (3 * S^2 * Z * (S_{v5})) / (4 * \exp(2 * Z)) \dots \\
& + (2 * S * Y * Z * (S_{v5})) / \exp(2 * Z) + (S^2 * Y * Z * (S_{v5})) / \exp(2 * Z) + (S * Y^2 * Z * (S_{v5})) / \exp(3 * Z) + \\
& (3 * S * Y^2 * Z * (S_{v5})) / (2 * \exp(2 * Z)) + (S^2 * Y^2 * Z * (S_{v5})) / \exp(3 * Z) \dots \\
& + (S^2 * Y^2 * Z * (S_{v5})) / (2 * \exp(2 * Z)) - (2 * S * Y^3 * Z * (S_{v5})) / \exp(2 * Z) - \\
& (S^2 * Y^3 * Z * (S_{v5})) / \exp(2 * Z) + (3 * S * Y^4 * Z * (S_{v5})) / (4 * \exp(4 * Z)) - (S * Y^4 * Z * (S_{v5})) / \exp(3 * Z) \\
& \dots \\
& + (S * Y^4 * Z * (S_{v5})) / (4 * \exp(2 * Z)) + (3 * S^2 * Y^4 * Z * (S_{v5})) / (4 * \exp(4 * Z)) - \\
& (S^2 * Y^4 * Z * (S_{v5})) / \exp(3 * Z) + (S^2 * Y^4 * Z * (S_{v5})) / (4 * \exp(2 * Z)) + (S * Z^2 * (S_{v5})) / (2 * \exp(3 * Z)) \\
& \dots \\
& + (S^2 * Z^2 * (S_{v5})) / (2 * \exp(3 * Z)) - (S * Y^2 * Z^2 * (S_{v5})) / \exp(3 * Z) - \\
& (S^2 * Y^2 * Z^2 * (S_{v5})) / \exp(3 * Z) + (S * Y^4 * Z^2 * (S_{v5})) / (2 * \exp(3 * Z)) \dots \\
& + (S^2 * Y^4 * Z^2 * (S_{v5})) / (2 * \exp(3 * Z)) + (9 * S^2 * (S_{v5})^2) / (16 * \exp(6 * Z)) - \\
& (23 * S^2 * (S_{v5})^2) / (8 * \exp(4 * Z)) + (2 * S^2 * (S_{v5})^2) / \exp(3 * Z) + (S^2 * (S_{v5})^2) / (16 * \exp(2 * Z)) \dots
\end{aligned}$$

$$\begin{aligned}
& - (\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/2 - \exp(-3*Z - Y.*Z)*S^2*(S_{v5})^2 - \\
& (2*S^2.*Y.*(S_{v5})^2)/\exp(3*Z) - (S^2.*Y.*(S_{v5})^2)/\exp(2*Z) + (9*S^2.*Y.^2*(S_{v5})^2)/(8*\exp(6*Z)) \\
& \dots \\
& - (3*S^2.*Y.^2*(S_{v5})^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^2*(S_{v5})^2)/(2*\exp(4*Z)) - \\
& (7*S^2.*Y.^2*(S_{v5})^2)/(2*\exp(3*Z)) + (15*S^2.*Y.^2*(S_{v5})^2)/(8*\exp(2*Z)) \dots \\
& + (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/2 + \exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2 - \\
& (3*S^2.*Y.^3*(S_{v5})^2)/\exp(4*Z) + (4*S^2.*Y.^3*(S_{v5})^2)/\exp(3*Z) \dots \\
& - (S^2.*Y.^3*(S_{v5})^2)/\exp(2*Z) + (9*S^2.*Y.^4*(S_{v5})^2)/(16*\exp(6*Z)) - \\
& (3*S^2.*Y.^4*(S_{v5})^2)/(2*\exp(5*Z)) + (11*S^2.*Y.^4*(S_{v5})^2)/(8*\exp(4*Z)) \dots \\
& - (S^2.*Y.^4*(S_{v5})^2)/(2*\exp(3*Z)) + (S^2.*Y.^4*(S_{v5})^2)/(16*\exp(2*Z)) + \\
& (9*S^2*(S_{v5})^2)/(4*\exp(6*Z)*Z^4) - (6*S^2*(S_{v5})^2)/(\exp(5*Z)*Z^4) \dots \\
& + (11*S^2*(S_{v5})^2)/(2*\exp(4*Z)*Z^4) - (2*S^2*(S_{v5})^2)/(\exp(3*Z)*Z^4) + \\
& (S^2*(S_{v5})^2)/(4*\exp(2*Z)*Z^4) + (S^2*(S_{v5})^2)/(4*\exp(2.*Y.*Z)*Z^4) \dots \\
& + (9*\exp(-4*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(4*Z^4) - (6*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/Z^4 + \\
& (11*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(2*Z^4) \dots \\
& - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/Z^4 - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v5})^2)/(2*Z^4) + (12*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^4 - (11*\exp(-3*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^4 \dots \\
& + (4*\exp(-2*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^4 - (\exp(-Z - Y.*Z)*S^2*(S_{v5})^2)/(2*Z^4) + \\
& (12*S^2*(S_{v5})^2)/(\exp(5*Z)*Z^3) - (22*S^2*(S_{v5})^2)/(\exp(4*Z)*Z^3) \dots \\
& + (27*S^2*(S_{v5})^2)/(2*\exp(3*Z)*Z^3) - (4*S^2*(S_{v5})^2)/(\exp(2*Z)*Z^3) + \\
& (S^2*(S_{v5})^2)/(2*\exp(Z)*Z^3) - (S^2*(S_{v5})^2)/(2*\exp(3.*Y.*Z)*Z^3) \dots \\
& - (S^2*(S_{v5})^2)/(2*\exp(Y.*Z)*Z^3) - (3*\exp(-2*Z - 3.*Y.*Z)*S^2*(S_{v5})^2)/(2*Z^3) + (2*\exp(-Z - \\
& 3.*Y.*Z)*S^2*(S_{v5})^2)/Z^3 - (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(2*Z^3) \dots \\
& + (2*\exp(-2*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/Z^3 - (\exp(-Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(2*Z^3) - (9*\exp(- \\
& 4*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^3 + (18*\exp(-3*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^3 \dots \\
& - (25*\exp(-2*Z - Y.*Z)*S^2*(S_{v5})^2)/(2*Z^3) + (4*\exp(-Z - Y.*Z)*S^2*(S_{v5})^2)/Z^3 - \\
& (9*S^2.*Y.*(S_{v5})^2)/(2*\exp(5*Z)*Z^3) + (12*S^2.*Y.*(S_{v5})^2)/(\exp(4*Z)*Z^3) \dots \\
& - (11*S^2.*Y.*(S_{v5})^2)/(\exp(3*Z)*Z^3) + (4*S^2.*Y.*(S_{v5})^2)/(\exp(2*Z)*Z^3) - \\
& (S^2.*Y.*(S_{v5})^2)/(2*\exp(Z)*Z^3) + (S^2.*Y.*(S_{v5})^2)/(2*\exp(Y.*Z)*Z^3) \dots \\
& + (9*\exp(-4*Z - Y.*Z)*S^2.*Y.*(S_{v5})^2)/(2*Z^3) - (12*\exp(-3*Z - Y.*Z)*S^2.*Y.*(S_{v5})^2)/Z^3 + \\
& (11*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_{v5})^2)/Z^3 \dots \\
& - (4*\exp(-Z - Y.*Z)*S^2.*Y.*(S_{v5})^2)/Z^3 + (S^2*(S_{v5})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v5})^2)/(4*\exp(6*Z)*Z^2) - (3*S^2*(S_{v5})^2)/(\exp(5*Z)*Z^2) + \\
& (19*S^2*(S_{v5})^2)/(\exp(4*Z)*Z^2) \dots \\
& - (19*S^2*(S_{v5})^2)/(\exp(3*Z)*Z^2) + (35*S^2*(S_{v5})^2)/(4*\exp(2*Z)*Z^2) - \\
& (2*S^2*(S_{v5})^2)/(\exp(Z)*Z^2) + (S^2*(S_{v5})^2)/(4*\exp(4.*Y.*Z)*Z^2) \dots \\
& + (S^2*(S_{v5})^2)/(2*\exp(2.*Y.*Z)*Z^2) + (\exp(-Z - 3.*Y.*Z)*S^2*(S_{v5})^2)/Z^2 + (5*\exp(-2*Z - \\
& 2.*Y.*Z)*S^2*(S_{v5})^2)/Z^2 - (2*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/Z^2 \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S^2*(S_{v5})^2)/(4*Z^2) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^2 + (5*\exp(- \\
& 3*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^2 - (\exp(-2*Z - Y.*Z)*S^2*(S_{v5})^2)/Z^2 \dots \\
& + (\exp(-Z - Y.*Z)*S^2*(S_{v5})^2)/(4*Z^2) - (S^2.*Y.*(S_{v5})^2)/(2*Z^2) - \\
& (15*S^2.*Y.*(S_{v5})^2)/(\exp(4*Z)*Z^2) + (26*S^2.*Y.*(S_{v5})^2)/(\exp(3*Z)*Z^2) \dots \\
& - (29*S^2.*Y.*(S_{v5})^2)/(2*\exp(2*Z)*Z^2) + (4*S^2.*Y.*(S_{v5})^2)/(\exp(Z)*Z^2) - \\
& (S^2.*Y.*(S_{v5})^2)/(2*\exp(2.*Y.*Z)*Z^2) - (3*\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.*(S_{v5})^2)/(2*Z^2) \dots \\
& + (2*\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_{v5})^2)/Z^2 + (S^2.*Y.^2*(S_{v5})^2)/(4*Z^2) + \\
& (9*S^2.*Y.^2*(S_{v5})^2)/(4*\exp(6*Z)*Z^2) - (6*S^2.*Y.^2*(S_{v5})^2)/(\exp(5*Z)*Z^2) \dots \\
& + (31*S^2.*Y.^2*(S_{v5})^2)/(4*\exp(4*Z)*Z^2) - (8*S^2.*Y.^2*(S_{v5})^2)/(\exp(3*Z)*Z^2) + \\
& (23*S^2.*Y.^2*(S_{v5})^2)/(4*\exp(2*Z)*Z^2) - (2*S^2.*Y.^2*(S_{v5})^2)/(\exp(Z)*Z^2) \dots \\
& - (9*\exp(-5*Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/(4*Z^2) + (6*\exp(-4*Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/Z^2 \\
& - (11*\exp(-3*Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/(2*Z^2) \dots \\
& + (2*\exp(-2*Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/Z^2 - (\exp(-Z - Y.*Z)*S^2.*Y.^2*(S_{v5})^2)/(4*Z^2) + \\
& (9*S^2*(S_{v5})^2)/(2*\exp(5*Z)*Z) - (S^2*(S_{v5})^2)/(\exp(4*Z)*Z) \dots \\
& + (25*S^2*(S_{v5})^2)/(4*\exp(3*Z)*Z) - (3*S^2*(S_{v5})^2)/(\exp(2*Z)*Z) + \\
& (3*S^2*(S_{v5})^2)/(4*\exp(Z)*Z) + (3*\exp(-3*Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(4*Z) \dots \\
& + (3*\exp(-Z - 2.*Y.*Z)*S^2*(S_{v5})^2)/(4*Z) + (3*\exp(-4*Z - Y.*Z)*S^2*(S_{v5})^2)/Z - (2*\exp(-3*Z - \\
& Y.*Z)*S^2*(S_{v5})^2)/Z + (2*\exp(-2*Z - Y.*Z)*S^2*(S_{v5})^2)/Z \dots
\end{aligned}$$

$$\begin{aligned}
& - \frac{(9*S^2.*Y.*(S_v5)^2)/(4*\exp(5*Z)*Z)}{(11*S^2.*Y.*(S_v5)^2)/(\exp(3*Z)*Z) + (7*S^2.*Y.*(S_v5)^2)/(\exp(2*Z)*Z) \dots} + \frac{(3*S^2.*Y.*(S_v5)^2)/(\exp(4*Z)*Z)}{(7*S^2.*Y.*(S_v5)^2)/(4*\exp(Z)*Z) - (\exp(-Z - 2.*Y.*Z)*S^2.*Y.*(S_v5)^2)/Z - (2*\exp(-2*Z - Y.*Z)*S^2.*Y.*(S_v5)^2)/Z + (15*S^2.*Y.^2*(S_v5)^2)/(2*\exp(5*Z)*Z) \dots} - \\
& - \frac{(13*S^2.*Y.^2*(S_v5)^2)/(\exp(4*Z)*Z)}{(6*S^2.*Y.^2*(S_v5)^2)/(\exp(2*Z)*Z) + (5*S^2.*Y.^2*(S_v5)^2)/(4*\exp(Z)*Z) \dots} + \frac{(41*S^2.*Y.^2*(S_v5)^2)/(4*\exp(3*Z)*Z)}{(3*\exp(-3*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v5)^2)/(4*Z) - (\exp(-2*Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v5)^2)/Z + (\exp(-Z - 2.*Y.*Z)*S^2.*Y.^2*(S_v5)^2)/(4*Z) \dots} - \\
& - \frac{(9*S^2.*Y.^3*(S_v5)^2)/(4*\exp(5*Z)*Z)}{(11*S^2.*Y.^3*(S_v5)^2)/(2*\exp(3*Z)*Z) + (2*S^2.*Y.^3*(S_v5)^2)/(\exp(2*Z)*Z) \dots} + \frac{(6*S^2.*Y.^3*(S_v5)^2)/(\exp(4*Z)*Z)}{(S^2.*Y.^3*(S_v5)^2)/(4*\exp(Z)*Z) - (3*S^2.*Z*(S_v5)^2)/(4*\exp(5*Z))} - \\
& (3*S^2.*Z*(S_v5)^2)/(4*\exp(3*Z)) + (S^2.*Y.*Z*(S_v5)^2)/\exp(3*Z) + \\
& + \frac{(S^2.*Y.^2*Z*(S_v5)^2)/(2*\exp(3*Z))}{(3*S^2.*Y.^4*Z*(S_v5)^2)/(4*\exp(5*Z)) - (S^2.*Y.^4*Z*(S_v5)^2)/\exp(4*Z) \dots} - \frac{(S^2.*Y.^3*Z*(S_v5)^2)/\exp(3*Z)}{(S^2.*Y.^4*Z*(S_v5)^2)/(4*\exp(3*Z)) + (S^2.*Z^2*(S_v5)^2)/(4*\exp(4*Z))} - \\
& (S^2.*Y.^2*Z^2*(S_v5)^2)/(2*\exp(4*Z)) + (S^2.*Y.^4*Z^2*(S_v5)^2)/(4*\exp(4*Z));
\end{aligned}$$

```

Ns5=Nf+Nc+Ny5;
Phi5=Nf./[Nc+Ny5];
Be5=1./[1+Phi5];
Gf5=Nf./Ns5;
Gh5=[Nc+Ny5]./Ns5;
Nh5=Nc+Ny5;

```

```

plot(Y,Ns1,'b',Y,Ns2,'g',Y,Ns3,'r',Y,Ns4,'k',Y,Ns5,'m')

```

```

% plot(Y,Be1,'b',Y,Be2,'g',Y,Be3,'r',Y,Be4,'k',Y,Be5,'m')

```

```

% plot(Y,Phi1,'b',Y,Phi2,'g',Y,Phi3,'r',Y,Phi4,'k',Y,Phi5,'m')

```

```

% plot(Y,Gf1,'b',Y,Gf2,'g',Y,Gf3,'r',Y,Gf4,'k',Y,Gf5,'m')

```

```

% plot(Y,Gh1,'b',Y,Gh2,'g',Y,Gh3,'r',Y,Gh4,'k',Y,Gh5,'m')

```

```

% plot(Y,Nf1,'b',Y,Nf2,'g',Y,Nf3,'r',Y,Nf4,'k',Y,Nf5,'m')

```

```

% plot(Y,Nh1,'b',Y,Nh2,'g',Y,Nh3,'r',Y,Nh4,'k',Y,Nh5,'m')

```

```

% plot(Nh1,Nf1,'b',Nh2,Nf2,'g',Nh3,Nf3,'r',Nh4,Nf4,'k',Nh5,Nf5,'m')

```

PLOTTOOLS ON

2. PROGRAMS FOR CIRCULAR MICROTUBE

2.1. Distribution of $N_S, Be, \Phi, G_F, G_R, N_F$ and N_H versus R for a range of

Br and set of S, S_v, Z & Pe

$S=1; S_v=1; Z=1; Pe=10;$

$\% S=5; S_v=0.75; Z=7.5; Pe=2;$

$\% \% \% S=2; S_v=1; Z=5; Pe=0.5;$

$\% \% \% S=25; S_v=15; Z=10; Pe=2.5;$

$\% \% \% S=20; S_v=2; Z=2.5; Pe=0.5;$

$\% \% \% S=10; S_v=25; Z=20; Pe=5;$

$q=1.86;$

$s=1;$

$Dh=250 \cdot 10^{-6};$

$R=0.005:1;$

$Nc=[1/Pe^2] \cdot [16 \cdot q^2 + s^2 \cdot Dh^2 + 8 \cdot q \cdot s \cdot Dh];$

$$\begin{aligned} Nr = & (R.^2 \cdot S^2)/4 + (25 \cdot R.^2 \cdot S^2 \cdot (S_v))/(384 \cdot (1 + Z^2/4 + Z^4/64)^2) + \\ & (R.^2 \cdot R \cdot Z^2 \cdot S^2 \cdot (S_v))/(4 \cdot (1 + Z^2/4 + Z^4/64)^2) - \dots \\ & (43 \cdot R.^4 \cdot S^2 \cdot Z^2 \cdot (S_v))/(384 \cdot (1 + Z^2/4 + Z^4/64)^2) \dots \\ & + (5 \cdot R.^5 \cdot R \cdot Z \cdot S^2 \cdot Z^3 \cdot (S_v))/(32 \cdot (1 + Z^2/4 + Z^4/64)^2) + (407 \cdot R.^6 \cdot S^2 \cdot Z^4 \cdot (S_v))/(4096 \cdot (1 \\ & + Z^2/4 + Z^4/64)^2) + \dots \\ & (7 \cdot R.^7 \cdot R \cdot Z \cdot S^2 \cdot Z^5 \cdot (S_v))/(768 \cdot (1 + Z^2/4 + Z^4/64)^2) + (539 \cdot R.^8 \cdot S^2 \cdot Z^6 \cdot (S_v))/(4096 \cdot (1 \\ & + Z^2/4 + Z^4/64)^2) + \dots \\ & (85225 \cdot R.^{10} \cdot S^2 \cdot Z^8 \cdot (S_v))/(1572864 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (6487 \cdot R.^{12} \cdot S^2 \cdot Z^{10} \cdot (S_v))/(393216 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (17773 \cdot R.^{14} \cdot S^2 \cdot Z^{12} \cdot (S_v))/(4194304 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (2011 \cdot R.^{16} \cdot S^2 \cdot Z^{14} \cdot (S_v))/(2097152 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (206775 \cdot R.^{18} \cdot S^2 \cdot Z^{16} \cdot (S_v))/(1073741824 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (108275 \cdot R.^{20} \cdot S^2 \cdot Z^{18} \cdot (S_v))/(3221225472 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (512435 \cdot R.^{22} \cdot S^2 \cdot Z^{20} \cdot (S_v))/(103079215104 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (21031 \cdot R.^{24} \cdot S^2 \cdot Z^{22} \cdot (S_v))/(34359738368 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (272987 \cdot R.^{26} \cdot S^2 \cdot Z^{24} \cdot (S_v))/(4398046511104 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (11305 \cdot R.^{28} \cdot S^2 \cdot Z^{26} \cdot (S_v))/(219902325552 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (24225 \cdot R.^{30} \cdot S^2 \cdot Z^{28} \cdot (S_v))/(70368744177664 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (323 \cdot R.^{32} \cdot S^2 \cdot Z^{30} \cdot (S_v))/(17592186044416 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (27455 \cdot R.^{34} \cdot S^2 \cdot Z^{32} \cdot (S_v))/(36028797018963968 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (855 \cdot R.^{36} \cdot S^2 \cdot Z^{34} \cdot (S_v))/(36028797018963968 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (1805 \cdot R.^{38} \cdot S^2 \cdot Z^{36} \cdot (S_v))/(3458764513820540928 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (25 \cdot R.^{40} \cdot S^2 \cdot Z^{38} \cdot (S_v))/(3458764513820540928 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (7 \cdot R.^{42} \cdot S^2 \cdot Z^{40} \cdot (S_v))/(147573952589676412928 \cdot (1 + Z^2/4 + Z^4/64)^2) + \dots \\ & (625 \cdot R.^2 \cdot S^2 \cdot (S_v)^2)/(147456 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (25 \cdot R.^2 \cdot R \cdot Z^2 \cdot S^2 \cdot (S_v)^2)/(768 \cdot (1 + Z^2/4 + Z^4/64)^4) + (R.^2 \cdot R \cdot Z^4 \cdot S^2 \cdot (S_v)^2)/(16 \cdot (1 \\ & + Z^2/4 + Z^4/64)^4) - \dots \\ & (1075 \cdot R.^4 \cdot S^2 \cdot Z^2 \cdot (S_v)^2)/(73728 \cdot (1 + Z^2/4 + Z^4/64)^4) - \dots \\ & (43 \cdot R.^4 \cdot R \cdot Z^2 \cdot S^2 \cdot Z^2 \cdot (S_v)^2)/(768 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (125 \cdot R.^5 \cdot R \cdot Z \cdot S^2 \cdot Z^3 \cdot (S_v)^2)/(6144 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (5 \cdot R.^5 \cdot R \cdot Z^3 \cdot S^2 \cdot Z^3 \cdot (S_v)^2)/(64 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (60109 \cdot R.^6 \cdot S^2 \cdot Z^4 \cdot (S_v)^2)/(2359296 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (407 \cdot R.^6 \cdot R \cdot Z^2 \cdot S^2 \cdot Z^4 \cdot (S_v)^2)/(8192 \cdot (1 + Z^2/4 + Z^4/64)^4) - \dots \\ & (4985 \cdot R.^7 \cdot R \cdot Z \cdot S^2 \cdot Z^5 \cdot (S_v)^2)/(147456 \cdot (1 + Z^2/4 + Z^4/64)^4) + \dots \\ & (7 \cdot R.^7 \cdot R \cdot Z^3 \cdot S^2 \cdot Z^5 \cdot (S_v)^2)/(1536 \cdot (1 + Z^2/4 + Z^4/64)^4) - \dots \end{aligned}$$

$$\begin{aligned}
& (671.*R.^8*S^2*Z^6*(S_v)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) + \\
& (739.*R.^8.*R.*Z^2*S^2*Z^6*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z*S^2*Z^7*(S_v)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) - \\
& (3787661.*R.^10*S^2*Z^8*(S_v)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_v)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) + \\
& (67529.*R.^11.*R.*Z*S^2*Z^9*(S_v)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1627151.*R.^12*S^2*Z^10*(S_v)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19657.*R.^12.*R.*Z^2*S^2*Z^10*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z*S^2*Z^11*(S_v)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) + \\
& (241027273.*R.^14*S^2*Z^12*(S_v)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S^2*Z^12*(S_v)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z*S^2*Z^13*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (53842355.*R.^16*S^2*Z^14*(S_v)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^16.*R.*Z^2*S^2*Z^14*(S_v)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z*S^2*Z^15*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^18*S^2*Z^16*(S_v)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S^2*Z^16*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^19.*R.*Z*S^2*Z^17*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (944668661.*R.^20*S^2*Z^18*(S_v)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^20.*R.*Z^2*S^2*Z^18*(S_v)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z*S^2*Z^19*(S_v)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^22*S^2*Z^20*(S_v)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S^2*Z^20*(S_v)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z*S^2*Z^21*(S_v)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1484626111.*R.^24*S^2*Z^22*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^24.*R.*Z^2*S^2*Z^22*(S_v)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (10718225.*R.^25.*R.*Z*S^2*Z^23*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^26*S^2*Z^24*(S_v)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S^2*Z^24*(S_v)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^27.*R.*Z*S^2*Z^25*(S_v)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24750045961.*R.^28*S^2*Z^26*(S_v)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^28.*R.*Z^2*S^2*Z^26*(S_v)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (6450277.*R.^29.*R.*Z*S^2*Z^27*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^30*S^2*Z^28*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S^2*Z^28*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^31.*R.*Z*S^2*Z^29*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^32*S^2*Z^30*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^32.*R.*Z^2*S^2*Z^30*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^33.*R.*Z*S^2*Z^31*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^34*S^2*Z^32*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S^2*Z^32*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^35.*R.*Z*S^2*Z^33*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^36*S^2*Z^34*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^36.*R.*Z^2*S^2*Z^34*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^37.*R.*Z*S^2*Z^35*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^38*S^2*Z^36*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^38.*R.*Z^2*S^2*Z^36*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^39.*R.*Z*S^2*Z^37*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^40*S^2*Z^38*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^40.*R.*Z^2*S^2*Z^38*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (32965.*R.^41.*R.*Z*S^2*Z^39*(S_v)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^42*S^2*Z^40*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^42.*R.*Z^2*S^2*Z^40*(S_v)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*S^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2057042720599.*R.^{46}.*S^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*S^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^{50}.*S^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^2/4 + Z^4/64)^4) + \\
& + ... \\
& (37823055319.*R.^{52}.*S^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (31266829573.*R.^{54}.*S^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (305764487.*R.^{56}.*S^2*Z^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (155671821505.*R.^{58}.*S^2*Z^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (8605263625.*R.^{60}.*S^2*Z^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4487015167.*R.^{62}.*S^2*Z^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (64197131.*R.^{64}.*S^2*Z^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (7366421503.*R.^{66}.*S^2*Z^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (118374655.*R.^{68}.*S^2*Z^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (103217975.*R.^{70}.*S^2*Z^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1169089.*R.^{72}.*S^2*Z^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (16453715.*R.^{74}.*S^2*Z^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (234365.*R.^{76}.*S^2*Z^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (77905.*R.^{78}.*S^2*Z^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (175.*R.^{80}.*S^2*Z^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (49.*R.^{82}.*S^2*Z^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 + Z^4/64)^4);
\end{aligned}$$

$$Br1=0.2;$$

$$Nf1=Br1*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)/(4096 + 2048*Z^2 + 384*Z^4 + 32*Z^6 + Z^8)];$$

$$Ns1=Nf1+Nc+Nr;$$

$$Phi1=Nf1./[Nc+Nr];$$

$$Be1=1./[1+Phi1];$$

$$Gf1=Nf1./Ns1;$$

$$Gr1=[Nr]./Ns1;$$

$$Br2=0.4;$$

```

Nf2=Br2*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)./(4096 + 2048*Z^2 + 384*Z^4 +
32*Z^6 + Z^8)];
Ns2=Nf2+Nc+Nr;
Phi2=Nf2./[Nc+Nr];
Be2=1./[1+Phi2];
Gf2=Nf2./Ns2;
Gr2=[Nr]./Ns2;

```

```

Br3=0.6;
Nf3=Br3*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)./(4096 + 2048*Z^2 + 384*Z^4 +
32*Z^6 + Z^8)];
Ns3=Nf3+Nc+Nr;
Phi3=Nf3./[Nc+Nr];
Be3=1./[1+Phi3];
Gf3=Nf3./Ns3;
Gr3=[Nr]./Ns3;

```

```

Br4=0.8;
Nf4=Br4*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)./(4096 + 2048*Z^2 + 384*Z^4 +
32*Z^6 + Z^8)];
Ns4=Nf4+Nc+Nr;
Phi4=Nf4./[Nc+Nr];
Be4=1./[1+Phi4];
Gf4=Nf4./Ns4;
Gr4=[Nr]./Ns4;

```

```

Br5=1;
Nf5=Br5*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)./(4096 + 2048*Z^2 + 384*Z^4 +
32*Z^6 + Z^8)];
Ns5=Nf5+Nc+Nr;
Phi5=Nf5./[Nc+Nr];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gr5=[Nr]./Ns5;

```

```

Nh=Nc+Nr;

```

```

plot(R,Ns1,'b',R,Ns2,'g',R,Ns3,'r',R,Ns4,'k',R,Ns5,'m')

% plot(R,Be1,'b',R,Be2,'g',R,Be3,'r',R,Be4,'k',R,Be5,'m')

% plot(R,Phi1,'b',R,Phi2,'g',R,Phi3,'r',R,Phi4,'k',R,Phi5,'m')

% plot(R,Gf1,'b',R,Gf2,'g',R,Gf3,'r',R,Gf4,'k',R,Gf5,'m')

% plot(R,Gr1,'b',R,Gr2,'g',R,Gr3,'r',R,Gr4,'k',R,Gr5,'m')

% plot(R,Nf1,'b',R,Nf2,'g',R,Nf3,'r',R,Nf4,'k',R,Nf5,'m')

% plot(R,Nh)

```

PLOTTOOLS ON

2.2. Distribution of $N_S, Be, \Phi, G_F, G_R, N_F$ and N_H versus Y for a range of

Z and set of S, S_v, Br & Pe

S=1; S_v=1; Br=1; Pe=10;
% S=5; S_v=2; Br=0.5; Pe=2;

% % % % S=20; S_v=5; Br=0.2; Pe=0.5;
% % % % S=2; S_v=1; Br=0.8; Pe=0.5;
% % % % S=7.5; S_v=15; Br=0.6; Pe=2.5;
% % % % S=10; S_v=5; Br=0.9; Pe=5;

q=1.86;
s=1;
Dh=250*10^-6;
R=0:0.005:1;

Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];

Z1=6.5;
Nf1=Br*[(Z1^2).exp(-2.*R.*Z1)+(Z1^2).exp(-2*Z1^2).exp(-Z1-R.*Z1)];
Nr1=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z1^2/4 + Z1^4/64)^2)+
(R.^2.*R.*Z1^2*S^2*(S_v))/(4*(1 + Z1^2/4 + Z1^4/64)^2) -...
(43.*R.^4*S^2*Z1^2*(S_v))/(384*(1 + Z1^2/4 + Z1^4/64)^2)...
+ (5.*R.^5.*R.*Z1*S^2*Z1^3*(S_v))/(32*(1 + Z1^2/4 + Z1^4/64)^2)+
(407.*R.^6*S^2*Z1^4*(S_v))/(4096*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(7.*R.^7.*R.*Z1*S^2*Z1^5*(S_v))/(768*(1 + Z1^2/4 + Z1^4/64)^2) +
(539.*R.^8*S^2*Z1^6*(S_v))/(4096*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(85225.*R.^10*S^2*Z1^8*(S_v))/(1572864*(1 + Z1^2/4 + Z1^4/64)^2) +
(6487.*R.^12*S^2*Z1^10*(S_v))/(393216*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(17773.*R.^14*S^2*Z1^12*(S_v))/(4194304*(1 + Z1^2/4 + Z1^4/64)^2) +
(2011.*R.^16*S^2*Z1^14*(S_v))/(2097152*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(206775.*R.^18*S^2*Z1^16*(S_v))/(1073741824*(1 + Z1^2/4 + Z1^4/64)^2) +
(108275.*R.^20*S^2*Z1^18*(S_v))/(3221225472*(1 + Z1^2/4 + Z1^4/64)^2) +...
(512435.*R.^22*S^2*Z1^20*(S_v))/(103079215104*(1 + Z1^2/4 + Z1^4/64)^2) +
(21031.*R.^24*S^2*Z1^22*(S_v))/(34359738368*(1 + Z1^2/4 + Z1^4/64)^2) +...
(272987.*R.^26*S^2*Z1^24*(S_v))/(4398046511104*(1 + Z1^2/4 + Z1^4/64)^2) +
(11305.*R.^28*S^2*Z1^26*(S_v))/(2199023255552*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(24225.*R.^30*S^2*Z1^28*(S_v))/(70368744177664*(1 + Z1^2/4 + Z1^4/64)^2) +
(323.*R.^32*S^2*Z1^30*(S_v))/(17592186044416*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(27455.*R.^34*S^2*Z1^32*(S_v))/(36028797018963968*(1 + Z1^2/4 + Z1^4/64)^2) +
(855.*R.^36*S^2*Z1^34*(S_v))/(36028797018963968*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(1805.*R.^38*S^2*Z1^36*(S_v))/(3458764513820540928*(1 + Z1^2/4 + Z1^4/64)^2) +
(25.*R.^40*S^2*Z1^38*(S_v))/(3458764513820540928*(1 + Z1^2/4 + Z1^4/64)^2) + ...
(7.*R.^42*S^2*Z1^40*(S_v))/(147573952589676412928*(1 + Z1^2/4 + Z1^4/64)^2) +
(625.*R.^2*S^2*(S_v)^2)/(147456*(1 + Z1^2/4 + Z1^4/64)^4) + ...
(25.*R.^2.*R.*Z1^2*S^2*(S_v)^2)/(768*(1 + Z1^2/4 + Z1^4/64)^4) +
(R.^2.*R.*Z1^4*S^2*(S_v)^2)/(16*(1 + Z1^2/4 + Z1^4/64)^4) - ...
(1075.*R.^4*S^2*Z1^2*(S_v)^2)/(73728*(1 + Z1^2/4 + Z1^4/64)^4) -
(43.*R.^4.*R.*Z1^2*S^2*Z1^2*(S_v)^2)/(768*(1 + Z1^2/4 + Z1^4/64)^4) + ...

$$\begin{aligned}
& (125.*R.^5.*R.*Z1*S^2*Z1^3*(S_v)^2)/(6144*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (5.*R.^5.*R.*Z1^3*S^2*Z1^3*(S_v)^2)/(64*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (60109.*R.^6.*R.*Z1^4*(S_v)^2)/(2359296*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (407.*R.^6.*R.*Z1^2*S^2*Z1^4*(S_v)^2)/(8192*(1 + Z1^2/4 + Z1^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z1*S^2*Z1^5*(S_v)^2)/(147456*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (7.*R.^7.*R.*Z1^3*S^2*Z1^5*(S_v)^2)/(1536*(1 + Z1^2/4 + Z1^4/64)^4) - ... \\
& (671.*R.^8.*R.*Z1^6*(S_v)^2)/(131072*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (739.*R.^8.*R.*Z1^2*S^2*Z1^6*(S_v)^2)/(8192*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z1*S^2*Z1^7*(S_v)^2)/(589824*(1 + Z1^2/4 + Z1^4/64)^4) - \\
& (3787661.*R.^10.*R.*Z1^8*(S_v)^2)/(301989888*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z1^2*S^2*Z1^8*(S_v)^2)/(1048576*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (67529.*R.^11.*R.*Z1*S^2*Z1^9*(S_v)^2)/(1572864*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (1627151.*R.^12.*R.*Z1^10*(S_v)^2)/(100663296*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (19657.*R.^12.*R.*Z1^2*S^2*Z1^10*(S_v)^2)/(2359296*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z1*S^2*Z1^11*(S_v)^2)/(25165824*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (241027273.*R.^14.*R.*Z1^12*(S_v)^2)/(9663676416*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z1^2*S^2*Z1^12*(S_v)^2)/(8388608*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z1*S^2*Z1^13*(S_v)^2)/(603979776*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (53842355.*R.^16.*R.*Z1^14*(S_v)^2)/(3221225472*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (2011.*R.^16.*R.*Z1^2*S^2*Z1^14*(S_v)^2)/(4194304*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z1*S^2*Z1^15*(S_v)^2)/(603979776*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (19618549477.*R.^18.*R.*Z1^16*(S_v)^2)/(2473901162496*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z1^2*S^2*Z1^16*(S_v)^2)/(2147483648*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (607051.*R.^19.*R.*Z1*S^2*Z1^17*(S_v)^2)/(1610612736*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (944668661.*R.^20.*R.*Z1^18*(S_v)^2)/(309237645312*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (108275.*R.^20.*R.*Z1^2*S^2*Z1^18*(S_v)^2)/(6442450944*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z1*S^2*Z1^19*(S_v)^2)/(51539607552*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (3348433219.*R.^22.*R.*Z1^20*(S_v)^2)/(3298534883328*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z1^2*S^2*Z1^20*(S_v)^2)/(206158430208*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z1*S^2*Z1^21*(S_v)^2)/(412316860416*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (1484626111.*R.^24.*R.*Z1^22*(S_v)^2)/(4947802324992*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (21031.*R.^24.*R.*Z1^2*S^2*Z1^22*(S_v)^2)/(68719476736*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (10718225.*R.^25.*R.*Z1*S^2*Z1^23*(S_v)^2)/(4947802324992*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (33848465467.*R.^26.*R.*Z1^24*(S_v)^2)/(422212465065984*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (272987.*R.^26.*R.*Z1^2*S^2*Z1^24*(S_v)^2)/(8796093022208*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (11158205.*R.^27.*R.*Z1*S^2*Z1^25*(S_v)^2)/(39582418599936*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (24750045961.*R.^28.*R.*Z1^26*(S_v)^2)/(1266637395197952*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (11305.*R.^28.*R.*Z1^2*S^2*Z1^26*(S_v)^2)/(4398046511104*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (6450277.*R.^29.*R.*Z1*S^2*Z1^27*(S_v)^2)/(211106232532992*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (59064594011.*R.^30.*R.*Z1^28*(S_v)^2)/(13510798882111488*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (24225.*R.^30.*R.*Z1^2*S^2*Z1^28*(S_v)^2)/(140737488355328*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (4624109.*R.^31.*R.*Z1*S^2*Z1^29*(S_v)^2)/(1688849860263936*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (36553306561.*R.^32.*R.*Z1^30*(S_v)^2)/(40532396646334464*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (323.*R.^32.*R.*Z1^2*S^2*Z1^30*(S_v)^2)/(35184372088832*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (679915.*R.^33.*R.*Z1*S^2*Z1^31*(S_v)^2)/(3377699720527872*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (1189947216611.*R.^34.*R.*Z1^32*(S_v)^2)/(6917529027641081856*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (27455.*R.^34.*R.*Z1^2*S^2*Z1^32*(S_v)^2)/(72057594037927936*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (108205.*R.^35.*R.*Z1*S^2*Z1^33*(S_v)^2)/(9007199254740992*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (105030792781.*R.^36.*R.*Z1^34*(S_v)^2)/(3458764513820540928*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (855.*R.^36.*R.*Z1^2*S^2*Z1^34*(S_v)^2)/(72057594037927936*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (990641.*R.^37.*R.*Z1*S^2*Z1^35*(S_v)^2)/(1729382256910270464*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (548568674633.*R.^38.*R.*Z1^36*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (1805.*R.^38.*R.*Z1^2*S^2*Z1^36*(S_v)^2)/(6917529027641081856*(1 + Z1^2/4 + Z1^4/64)^4) + ... \\
& (294785.*R.^39.*R.*Z1*S^2*Z1^37*(S_v)^2)/(13835058055282163712*(1 + Z1^2/4 + Z1^4/64)^4) + \\
& (10322387501.*R.^40.*R.*Z1^38*(S_v)^2)/...
\end{aligned}$$

$$\begin{aligned}
& (13835058055282163712*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (25.*R.^{40}.*R.*Z1^2*S^2*Z1^{38}*(S_v)^2)/(6917529027641081856*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \dots \\
& (32965.*R.^{41}.*R.*Z1*S^2*Z1^{39}*(S_v)^2)/(55340232221128654848*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (1462601471251.*R.^{42}.*S^2*Z1^{40}*(S_v)^2)/\dots \\
& (14167099448608935641088*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (7.*R.^{42}.*R.*Z1^2*S^2*Z1^{40}*(S_v)^2)/(295147905179352825856*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \dots \\
& (15635.*R.^{43}.*R.*Z1*S^2*Z1^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (185335180013.*R.^{44}.*S^2*Z1^{42}*(S_v)^2)/\dots \\
& (14167099448608935641088*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (3115.*R.^{45}.*R.*Z1*S^2*Z1^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \dots \\
& (2057042720599.*R.^{46}.*S^2*Z1^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (49.*R.^{47}.*R.*Z1*S^2*Z1^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (24026340573.*R.^{48}.*S^2*Z1^{46}*(S_v)^2)/\dots \\
& (151115727451828646838272*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& (5273670271697.*R.^{50}.*S^2*Z1^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (37823055319.*R.^{52}.*S^2*Z1^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (31266829573.*R.^{54}.*S^2*Z1^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (305764487.*R.^{56}.*S^2*Z1^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z1^{1/2}/4 + Z1^{4/64})^4) + \\
& \dots \\
& (155671821505.*R.^{58}.*S^2*Z1^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (8605263625.*R.^{60}.*S^2*Z1^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (4487015167.*R.^{62}.*S^2*Z1^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (64197131.*R.^{64}.*S^2*Z1^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (7366421503.*R.^{66}.*S^2*Z1^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (118374655.*R.^{68}.*S^2*Z1^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (103217975.*R.^{70}.*S^2*Z1^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (1169089.*R.^{72}.*S^2*Z1^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (16453715.*R.^{74}.*S^2*Z1^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (234365.*R.^{76}.*S^2*Z1^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (77905.*R.^{78}.*S^2*Z1^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (175.*R.^{80}.*S^2*Z1^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4) + \dots \\
& (49.*R.^{82}.*S^2*Z1^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z1^{1/2}/4 + \\
& Z1^{4/64})^4);
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf1 + Nc + Nr1; \\
Phi1 &= Nf1./[Nc + Nr1]; \\
Be1 &= 1./[1 + Phi1]; \\
Gf1 &= Nf1./Ns1; \\
Gr1 &= [Nr1]./Ns1; \\
Nh1 &= Nc + Nr1;
\end{aligned}$$

$Z2=7.5;$
 $Nf2=Br*[(Z2^2).exp(-2.*R.*Z2)+(Z2^2)*exp(-2*Z2)-2*Z2^2.*exp(-Z2-R.*Z2)];$
 $Nr2=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z2^2/4 + Z2^4/64)^2)+$
 $(R.^2.*R.*Z2^2*S^2*(S_v))/(4*(1 + Z2^2/4 + Z2^4/64)^2) - ...$
 $(43.*R.^4*S^2*Z2^2*(S_v))/(384*(1 + Z2^2/4 + Z2^4/64)^2)...$
 $+ (5.*R.^5.*R.*Z2*S^2*Z2^3*(S_v))/(32*(1 + Z2^2/4 + Z2^4/64)^2)+$
 $(407.*R.^6*S^2*Z2^4*(S_v))/(4096*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(7.*R.^7.*R.*Z2*S^2*Z2^5*(S_v))/(768*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(539.*R.^8*S^2*Z2^6*(S_v))/(4096*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(85225.*R.^10*S^2*Z2^8*(S_v))/(1572864*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(6487.*R.^12*S^2*Z2^10*(S_v))/(393216*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(17773.*R.^14*S^2*Z2^12*(S_v))/(4194304*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(2011.*R.^16*S^2*Z2^14*(S_v))/(2097152*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(206775.*R.^18*S^2*Z2^16*(S_v))/(1073741824*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(108275.*R.^20*S^2*Z2^18*(S_v))/(3221225472*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(512435.*R.^22*S^2*Z2^20*(S_v))/(103079215104*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(21031.*R.^24*S^2*Z2^22*(S_v))/(34359738368*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(272987.*R.^26*S^2*Z2^24*(S_v))/(4398046511104*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(11305.*R.^28*S^2*Z2^26*(S_v))/(2199023255552*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(24225.*R.^30*S^2*Z2^28*(S_v))/(70368744177664*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(323.*R.^32*S^2*Z2^30*(S_v))/(17592186044416*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(27455.*R.^34*S^2*Z2^32*(S_v))/(36028797018963968*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(855.*R.^36*S^2*Z2^34*(S_v))/(36028797018963968*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(1805.*R.^38*S^2*Z2^36*(S_v))/(3458764513820540928*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(25.*R.^40*S^2*Z2^38*(S_v))/(3458764513820540928*(1 + Z2^2/4 + Z2^4/64)^2) + ...$
 $(7.*R.^42*S^2*Z2^40*(S_v))/(147573952589676412928*(1 + Z2^2/4 + Z2^4/64)^2) +$
 $(625.*R.^2*S^2*(S_v)^2)/(147456*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(25.*R.^2.*R.*Z2^2*S^2*(S_v)^2)/(768*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(R.^2.*R.*Z2^4*S^2*(S_v)^2)/(16*(1 + Z2^2/4 + Z2^4/64)^4) - ...$
 $(1075.*R.^4*S^2*Z2^2*(S_v)^2)/(73728*(1 + Z2^2/4 + Z2^4/64)^4) -$
 $(43.*R.^4.*R.*Z2^2*S^2*Z2^2*(S_v)^2)/(768*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(125.*R.^5.*R.*Z2*S^2*Z2^3*(S_v)^2)/(6144*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(5.*R.^5.*R.*Z2^3*S^2*Z2^3*(S_v)^2)/(64*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(60109.*R.^6*S^2*Z2^4*(S_v)^2)/(2359296*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(407.*R.^6.*R.*Z2^2*S^2*Z2^4*(S_v)^2)/(8192*(1 + Z2^2/4 + Z2^4/64)^4) - ...$
 $(4985.*R.^7.*R.*Z2*S^2*Z2^5*(S_v)^2)/(147456*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(7.*R.^7.*R.*Z2^3*S^2*Z2^5*(S_v)^2)/(1536*(1 + Z2^2/4 + Z2^4/64)^4) - ...$
 $(671.*R.^8*S^2*Z2^6*(S_v)^2)/(131072*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(739.*R.^8.*R.*Z2^2*S^2*Z2^6*(S_v)^2)/(8192*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(17111.*R.^9.*R.*Z2*S^2*Z2^7*(S_v)^2)/(589824*(1 + Z2^2/4 + Z2^4/64)^4) -$
 $(3787661.*R.^10*S^2*Z2^8*(S_v)^2)/(301989888*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(31395.*R.^10.*R.*Z2^2*S^2*Z2^8*(S_v)^2)/(1048576*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(67529.*R.^11.*R.*Z2*S^2*Z2^9*(S_v)^2)/(1572864*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(1627151.*R.^12*S^2*Z2^10*(S_v)^2)/(100663296*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(19657.*R.^12.*R.*Z2^2*S^2*Z2^10*(S_v)^2)/(2359296*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(486493.*R.^13.*R.*Z2*S^2*Z2^11*(S_v)^2)/(25165824*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(241027273.*R.^14*S^2*Z2^12*(S_v)^2)/(9663676416*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(17773.*R.^14.*R.*Z2^2*S^2*Z2^12*(S_v)^2)/(8388608*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(3710335.*R.^15.*R.*Z2*S^2*Z2^13*(S_v)^2)/(603979776*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(53842355.*R.^16*S^2*Z2^14*(S_v)^2)/(3221225472*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(2011.*R.^16.*R.*Z2^2*S^2*Z2^14*(S_v)^2)/(4194304*(1 + Z2^2/4 + Z2^4/64)^4) + ...$
 $(981421.*R.^17.*R.*Z2*S^2*Z2^15*(S_v)^2)/(603979776*(1 + Z2^2/4 + Z2^4/64)^4) +$
 $(19618549477.*R.^18*S^2*Z2^16*(S_v)^2)/(2473901162496*(1 + Z2^2/4 + Z2^4/64)^4) + ...$

$$\begin{aligned}
& (206775.*R.^{18}.*R.*Z^2*S^2*Z^{16}*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^{19}.*R.*Z^2*S^2*Z^{17}*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (944668661.*R.^{20}.*R.*Z^2*S^2*Z^{18}*(S_v)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^{20}.*R.*Z^2*S^2*Z^{18}*(S_v)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4002553.*R.^{21}.*R.*Z^2*S^2*Z^{19}*(S_v)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^{22}.*R.*Z^2*S^2*Z^{20}*(S_v)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (512435.*R.^{22}.*R.*Z^2*S^2*Z^{20}*(S_v)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^{23}.*R.*Z^2*S^2*Z^{21}*(S_v)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1484626111.*R.^{24}.*R.*Z^2*S^2*Z^{22}*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^{24}.*R.*Z^2*S^2*Z^{22}*(S_v)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (10718225.*R.^{25}.*R.*Z^2*S^2*Z^{23}*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^{26}.*R.*Z^2*S^2*Z^{24}*(S_v)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (272987.*R.^{26}.*R.*Z^2*S^2*Z^{24}*(S_v)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^{27}.*R.*Z^2*S^2*Z^{25}*(S_v)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24750045961.*R.^{28}.*R.*Z^2*S^2*Z^{26}*(S_v)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^{28}.*R.*Z^2*S^2*Z^{26}*(S_v)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (6450277.*R.^{29}.*R.*Z^2*S^2*Z^{27}*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^{31}.*R.*Z^2*S^2*Z^{29}*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^{33}.*R.*Z^2*S^2*Z^{31}*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^{35}.*R.*Z^2*S^2*Z^{33}*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^{37}.*R.*Z^2*S^2*Z^{35}*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^{39}.*R.*Z^2*S^2*Z^{37}*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (32965.*R.^{41}.*R.*Z^2*S^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (15635.*R.^{43}.*R.*Z^2*S^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*R.*Z^2*S^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z^2*S^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2057042720599.*R.^{46}.*R.*Z^2*S^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (49.*R.^{47}.*R.*Z^2*S^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*R.*Z^2*S^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^{50}.*R.*Z^2*S^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (37823055319.*R.^{52}.*R.*Z^2*S^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31266829573.*R.^{54}.*R.*Z^2*S^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) + ...
\end{aligned}$$

$(305764487.*R.^{56}*S^2*Z2^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z2^{2/4} + Z2^{4/64})^4) +$
 \dots
 $(155671821505.*R.^{58}*S^2*Z2^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(8605263625.*R.^{60}*S^2*Z2^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(4487015167.*R.^{62}*S^2*Z2^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(64197131.*R.^{64}*S^2*Z2^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(7366421503.*R.^{66}*S^2*Z2^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(118374655.*R.^{68}*S^2*Z2^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(103217975.*R.^{70}*S^2*Z2^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(1169089.*R.^{72}*S^2*Z2^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(16453715.*R.^{74}*S^2*Z2^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(234365.*R.^{76}*S^2*Z2^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(77905.*R.^{78}*S^2*Z2^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(175.*R.^{80}*S^2*Z2^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z2^{2/4} + Z2^{4/64})^4) + \dots$
 $(49.*R.^{82}*S^2*Z2^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z2^{2/4} + Z2^{4/64})^4);$

$Ns2=Nf2+Nc+Nr2;$
 $\Phi2=Nf2./[Nc+Nr2];$
 $Be2=1./[1+\Phi2];$
 $Gf2=Nf2./Ns2;$
 $Gr2=[Nr2]./Ns2;$
 $Nh2=Nc+Nr2;$

$Z3=10;$
 $Nf3=Br*[(Z3^2).*\exp(-2.*R.*Z3)+(Z3^2)*\exp(-2*Z3)-2*Z3^2.*\exp(-Z3-R.*Z3)];$
 $Nr3=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(R.^2.*R.*Z3^2*S^2*(S_v))/(4*(1 + Z3^{2/4} + Z3^{4/64})^2) - \dots$
 $(43.*R.^4*S^2*Z3^2*(S_v))/(384*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $+ (5.*R.^5.*R.*Z3*S^2*Z3^3*(S_v))/(32*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(407.*R.^6*S^2*Z3^4*(S_v))/(4096*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(7.*R.^7.*R.*Z3*S^2*Z3^5*(S_v))/(768*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(539.*R.^8*S^2*Z3^6*(S_v))/(4096*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(85225.*R.^10*S^2*Z3^8*(S_v))/(1572864*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(6487.*R.^12*S^2*Z3^10*(S_v))/(393216*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(17773.*R.^14*S^2*Z3^12*(S_v))/(4194304*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(2011.*R.^16*S^2*Z3^14*(S_v))/(2097152*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(206775.*R.^18*S^2*Z3^16*(S_v))/(1073741824*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(108275.*R.^20*S^2*Z3^18*(S_v))/(3221225472*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(512435.*R.^22*S^2*Z3^20*(S_v))/(103079215104*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(21031.*R.^24*S^2*Z3^22*(S_v))/(34359738368*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$
 $(272987.*R.^26*S^2*Z3^24*(S_v))/(4398046511104*(1 + Z3^{2/4} + Z3^{4/64})^2) +$
 $(11305.*R.^28*S^2*Z3^26*(S_v))/(2199023255552*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots$

$$\begin{aligned}
& (24225.*R.^{30}*S.^2*Z3^{28}*(S_v))/ (70368744177664*(1 + Z3^{2/4} + Z3^{4/64})^2) + \\
& (323.*R.^{32}*S.^2*Z3^{30}*(S_v))/ (17592186044416*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots \\
& (27455.*R.^{34}*S.^2*Z3^{32}*(S_v))/ (36028797018963968*(1 + Z3^{2/4} + Z3^{4/64})^2) + \\
& (855.*R.^{36}*S.^2*Z3^{34}*(S_v))/ (36028797018963968*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots \\
& (1805.*R.^{38}*S.^2*Z3^{36}*(S_v))/ (3458764513820540928*(1 + Z3^{2/4} + Z3^{4/64})^2) + \\
& (25.*R.^{40}*S.^2*Z3^{38}*(S_v))/ (3458764513820540928*(1 + Z3^{2/4} + Z3^{4/64})^2) + \dots \\
& (7.*R.^{42}*S.^2*Z3^{40}*(S_v))/ (147573952589676412928*(1 + Z3^{2/4} + Z3^{4/64})^2) + \\
& (625.*R.^2*S.^2*(S_v)^2)/ (147456*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (25.*R.^2.*R.*Z3^2*S.^2*(S_v)^2)/ (768*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (R.^2.*R.*Z3^4*S.^2*(S_v)^2)/ (16*(1 + Z3^{2/4} + Z3^{4/64})^4) - \dots \\
& (1075.*R.^4*S.^2*Z3^2*(S_v)^2)/ (73728*(1 + Z3^{2/4} + Z3^{4/64})^4) - \\
& (43.*R.^4.*R.*Z3^2*S.^2*Z3^2*(S_v)^2)/ (768*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (125.*R.^5.*R.*Z3^2*S.^2*Z3^3*(S_v)^2)/ (6144*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (5.*R.^5.*R.*Z3^3*S.^2*Z3^3*(S_v)^2)/ (64*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (60109.*R.^6*S.^2*Z3^4*(S_v)^2)/ (2359296*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (407.*R.^6.*R.*Z3^2*S.^2*Z3^4*(S_v)^2)/ (8192*(1 + Z3^{2/4} + Z3^{4/64})^4) - \dots \\
& (4985.*R.^7.*R.*Z3^2*S.^2*Z3^5*(S_v)^2)/ (147456*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (7.*R.^7.*R.*Z3^3*S.^2*Z3^5*(S_v)^2)/ (1536*(1 + Z3^{2/4} + Z3^{4/64})^4) - \dots \\
& (671.*R.^8*S.^2*Z3^6*(S_v)^2)/ (131072*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (739.*R.^8.*R.*Z3^2*S.^2*Z3^6*(S_v)^2)/ (8192*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (17111.*R.^9.*R.*Z3^2*S.^2*Z3^7*(S_v)^2)/ (589824*(1 + Z3^{2/4} + Z3^{4/64})^4) - \\
& (3787661.*R.^{10}*S.^2*Z3^8*(S_v)^2)/ (301989888*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (31395.*R.^{10}*R.*Z3^2*S.^2*Z3^8*(S_v)^2)/ (1048576*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (67529.*R.^{11}*R.*Z3^2*S.^2*Z3^9*(S_v)^2)/ (1572864*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (1627151.*R.^{12}*S.^2*Z3^{10}*(S_v)^2)/ (100663296*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (19657.*R.^{12}*R.*Z3^2*S.^2*Z3^{10}*(S_v)^2)/ (2359296*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (486493.*R.^{13}*R.*Z3^2*S.^2*Z3^{11}*(S_v)^2)/ (25165824*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (241027273.*R.^{14}*S.^2*Z3^{12}*(S_v)^2)/ (9663676416*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (17773.*R.^{14}*R.*Z3^2*S.^2*Z3^{12}*(S_v)^2)/ (8388608*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (3710335.*R.^{15}*R.*Z3^2*S.^2*Z3^{13}*(S_v)^2)/ (603979776*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (53842355.*R.^{16}*S.^2*Z3^{14}*(S_v)^2)/ (3221225472*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (2011.*R.^{16}*R.*Z3^2*S.^2*Z3^{14}*(S_v)^2)/ (4194304*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (981421.*R.^{17}*R.*Z3^2*S.^2*Z3^{15}*(S_v)^2)/ (603979776*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (19618549477.*R.^{18}*S.^2*Z3^{16}*(S_v)^2)/ (2473901162496*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (206775.*R.^{18}*R.*Z3^2*S.^2*Z3^{16}*(S_v)^2)/ (2147483648*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (607051.*R.^{19}*R.*Z3^2*S.^2*Z3^{17}*(S_v)^2)/ (1610612736*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (944668661.*R.^{20}*S.^2*Z3^{18}*(S_v)^2)/ (309237645312*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (108275.*R.^{20}*R.*Z3^2*S.^2*Z3^{18}*(S_v)^2)/ (6442450944*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (4002553.*R.^{21}*R.*Z3^2*S.^2*Z3^{19}*(S_v)^2)/ (51539607552*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (3348433219.*R.^{22}*S.^2*Z3^{20}*(S_v)^2)/ (3298534883328*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (512435.*R.^{22}*R.*Z3^2*S.^2*Z3^{20}*(S_v)^2)/ (206158430208*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (5778425.*R.^{23}*R.*Z3^2*S.^2*Z3^{21}*(S_v)^2)/ (412316860416*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (1484626111.*R.^{24}*S.^2*Z3^{22}*(S_v)^2)/ (4947802324992*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (21031.*R.^{24}*R.*Z3^2*S.^2*Z3^{22}*(S_v)^2)/ (68719476736*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (10718225.*R.^{25}*R.*Z3^2*S.^2*Z3^{23}*(S_v)^2)/ (4947802324992*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (33848465467.*R.^{26}*S.^2*Z3^{24}*(S_v)^2)/ (422212465065984*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (272987.*R.^{26}*R.*Z3^2*S.^2*Z3^{24}*(S_v)^2)/ (8796093022208*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (11158205.*R.^{27}*R.*Z3^2*S.^2*Z3^{25}*(S_v)^2)/ (39582418599936*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (24750045961.*R.^{28}*S.^2*Z3^{26}*(S_v)^2)/ (1266637395197952*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (11305.*R.^{28}*R.*Z3^2*S.^2*Z3^{26}*(S_v)^2)/ (4398046511104*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (6450277.*R.^{29}*R.*Z3^2*S.^2*Z3^{27}*(S_v)^2)/ (211106232532992*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (59064594011.*R.^{30}*S.^2*Z3^{28}*(S_v)^2)/ (13510798882111488*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (24225.*R.^{30}*R.*Z3^2*S.^2*Z3^{28}*(S_v)^2)/ (140737488355328*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (4624109.*R.^{31}*R.*Z3^2*S.^2*Z3^{29}*(S_v)^2)/ (1688849860263936*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (36553306561.*R.^{32}*S.^2*Z3^{30}*(S_v)^2)/ (40532396646334464*(1 + Z3^{2/4} + Z3^{4/64})^4) + \\
& (323.*R.^{32}*R.*Z3^2*S.^2*Z3^{30}*(S_v)^2)/ (35184372088832*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots
\end{aligned}$$

$$\begin{aligned}
& (679915.*R.^{33}.*R.*Z^3*S^2*Z^{31}*(S_v)^2)/(3377699720527872*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (1189947216611.*R.^{34}.*S^2*Z^{32}*(S_v)^2)/(6917529027641081856*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^3*S^2*Z^{32}*(S_v)^2)/(72057594037927936*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (108205.*R.^{35}.*R.*Z^3*S^2*Z^{33}*(S_v)^2)/(9007199254740992*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (105030792781.*R.^{36}.*S^2*Z^{34}*(S_v)^2)/(3458764513820540928*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (855.*R.^{36}.*R.*Z^3*S^2*Z^{34}*(S_v)^2)/(72057594037927936*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (990641.*R.^{37}.*R.*Z^3*S^2*Z^{35}*(S_v)^2)/(1729382256910270464*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (548568674633.*R.^{38}.*S^2*Z^{36}*(S_v)^2)/... \\
& (11068046442257309696*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^3*S^2*Z^{36}*(S_v)^2)/(6917529027641081856*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (294785.*R.^{39}.*R.*Z^3*S^2*Z^{37}*(S_v)^2)/(13835058055282163712*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (10322387501.*R.^{40}.*S^2*Z^{38}*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (25.*R.^{40}.*R.*Z^3*S^2*Z^{38}*(S_v)^2)/(6917529027641081856*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (32965.*R.^{41}.*R.*Z^3*S^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (1462601471251.*R.^{42}.*S^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (7.*R.^{42}.*R.*Z^3*S^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (15635.*R.^{43}.*R.*Z^3*S^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (185335180013.*R.^{44}.*S^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (3115.*R.^{45}.*R.*Z^3*S^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (2057042720599.*R.^{46}.*S^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (49.*R.^{47}.*R.*Z^3*S^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (24026340573.*R.^{48}.*S^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \\
& (5273670271697.*R.^{50}.*S^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (37823055319.*R.^{52}.*S^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (31266829573.*R.^{54}.*S^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (305764487.*R.^{56}.*S^2*Z^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (155671821505.*R.^{58}.*S^2*Z^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (8605263625.*R.^{60}.*S^2*Z^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (4487015167.*R.^{62}.*S^2*Z^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (64197131.*R.^{64}.*S^2*Z^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (7366421503.*R.^{66}.*S^2*Z^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (118374655.*R.^{68}.*S^2*Z^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (103217975.*R.^{70}.*S^2*Z^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (1169089.*R.^{72}.*S^2*Z^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (16453715.*R.^{74}.*S^2*Z^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots \\
& (234365.*R.^{76}.*S^2*Z^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{3/2}/4 + Z^{3/4}/64)^4) + \dots
\end{aligned}$$

$$\begin{aligned}
& (77905.*R.^{78}*S^2*Z3^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (175.*R.^{80}*S^2*Z3^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z3^{2/4} + Z3^{4/64})^4) + \dots \\
& (49.*R.^{82}*S^2*Z3^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z3^{2/4} + Z3^{4/64})^4);
\end{aligned}$$

$$\begin{aligned}
Ns3 &= Nf3 + Nc + Nr3; \\
Phi3 &= Nf3./[Nc + Nr3]; \\
Be3 &= 1./[1 + Phi3]; \\
Gf3 &= Nf3./Ns3; \\
Gr3 &= [Nr3]./Ns3; \\
Nh3 &= Nc + Nr3;
\end{aligned}$$

$$Z4 = 12.5;$$

$$\begin{aligned}
Nf4 &= Br*[(Z4^2).*exp(-2.*R.*Z4)/(Z4^2)*exp(-2*Z4^2).*exp(-Z4-R.*Z4)]; \\
Nr4 &= (R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z4^{2/4} + Z4^{4/64})^2) + \\
& (R.^2.*R.*Z4^2*S^2*(S_v))/(4*(1 + Z4^{2/4} + Z4^{4/64})^2) - \dots \\
& (43.*R.^4*S^2*Z4^2*(S_v))/(384*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& + (5.*R.^5.*R.*Z4*S^2*Z4^3*(S_v))/(32*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (407.*R.^6*S^2*Z4^4*(S_v))/(4096*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (7.*R.^7.*R.*Z4*S^2*Z4^5*(S_v))/(768*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (539.*R.^8*S^2*Z4^6*(S_v))/(4096*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (85225.*R.^10*S^2*Z4^8*(S_v))/(1572864*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (6487.*R.^12*S^2*Z4^{10}*(S_v))/(393216*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (17773.*R.^14*S^2*Z4^{12}*(S_v))/(4194304*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (2011.*R.^16*S^2*Z4^{14}*(S_v))/(2097152*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (206775.*R.^18*S^2*Z4^{16}*(S_v))/(1073741824*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (108275.*R.^20*S^2*Z4^{18}*(S_v))/(3221225472*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (512435.*R.^22*S^2*Z4^{20}*(S_v))/(103079215104*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (21031.*R.^24*S^2*Z4^{22}*(S_v))/(34359738368*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (272987.*R.^26*S^2*Z4^{24}*(S_v))/(4398046511104*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (11305.*R.^28*S^2*Z4^{26}*(S_v))/(2199023255552*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (24225.*R.^30*S^2*Z4^{28}*(S_v))/(70368744177664*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (323.*R.^32*S^2*Z4^{30}*(S_v))/(17592186044416*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (27455.*R.^34*S^2*Z4^{32}*(S_v))/(36028797018963968*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (855.*R.^36*S^2*Z4^{34}*(S_v))/(36028797018963968*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (1805.*R.^38*S^2*Z4^{36}*(S_v))/(3458764513820540928*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (25.*R.^40*S^2*Z4^{38}*(S_v))/(3458764513820540928*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (7.*R.^42*S^2*Z4^{40}*(S_v))/(147573952589676412928*(1 + Z4^{2/4} + Z4^{4/64})^2) + \dots \\
& (625.*R.^2*S^2*(S_v)^2)/(147456*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (25.*R.^2.*R.*Z4^2*S^2*(S_v)^2)/(768*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (R.^2.*R.*Z4^4*S^2*(S_v)^2)/(16*(1 + Z4^{2/4} + Z4^{4/64})^4) - \dots \\
& (1075.*R.^4*S^2*Z4^2*(S_v)^2)/(73728*(1 + Z4^{2/4} + Z4^{4/64})^4) - \dots \\
& (43.*R.^4.*R.*Z4^2*S^2*Z4^2*(S_v)^2)/(768*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (125.*R.^5.*R.*Z4*S^2*Z4^3*(S_v)^2)/(6144*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (5.*R.^5.*R.*Z4^3*S^2*Z4^3*(S_v)^2)/(64*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (60109.*R.^6*S^2*Z4^4*(S_v)^2)/(2359296*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (407.*R.^6.*R.*Z4^2*S^2*Z4^4*(S_v)^2)/(8192*(1 + Z4^{2/4} + Z4^{4/64})^4) - \dots \\
& (4985.*R.^7.*R.*Z4*S^2*Z4^5*(S_v)^2)/(147456*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (7.*R.^7.*R.*Z4^3*S^2*Z4^5*(S_v)^2)/(1536*(1 + Z4^{2/4} + Z4^{4/64})^4) - \dots \\
& (671.*R.^8*S^2*Z4^6*(S_v)^2)/(131072*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (739.*R.^8.*R.*Z4^2*S^2*Z4^6*(S_v)^2)/(8192*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots \\
& (17111.*R.^9.*R.*Z4*S^2*Z4^7*(S_v)^2)/(589824*(1 + Z4^{2/4} + Z4^{4/64})^4) - \dots \\
& (3787661.*R.^10*S^2*Z4^8*(S_v)^2)/(301989888*(1 + Z4^{2/4} + Z4^{4/64})^4) + \dots
\end{aligned}$$

$$\begin{aligned}
& (31395.*R.^{10}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1048576*(1 + Z^4/4 + Z^4/64)^4) + \\
& (67529.*R.^{11}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1572864*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (1627151.*R.^{12}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(100663296*(1 + Z^4/4 + Z^4/64)^4) + \\
& (19657.*R.^{12}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(2359296*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (486493.*R.^{13}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(25165824*(1 + Z^4/4 + Z^4/64)^4) + \\
& (241027273.*R.^{14}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(9663676416*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (17773.*R.^{14}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(8388608*(1 + Z^4/4 + Z^4/64)^4) + \\
& (3710335.*R.^{15}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(603979776*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (53842355.*R.^{16}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(3221225472*(1 + Z^4/4 + Z^4/64)^4) + \\
& (2011.*R.^{16}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(4194304*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (981421.*R.^{17}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(603979776*(1 + Z^4/4 + Z^4/64)^4) + \\
& (19618549477.*R.^{18}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(2473901162496*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (206775.*R.^{18}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(2147483648*(1 + Z^4/4 + Z^4/64)^4) + \\
& (607051.*R.^{19}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1610612736*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (944668661.*R.^{20}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(309237645312*(1 + Z^4/4 + Z^4/64)^4) + \\
& (108275.*R.^{20}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(6442450944*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (4002553.*R.^{21}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(51539607552*(1 + Z^4/4 + Z^4/64)^4) + \\
& (3348433219.*R.^{22}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(3298534883328*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (512435.*R.^{22}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(206158430208*(1 + Z^4/4 + Z^4/64)^4) + \\
& (5778425.*R.^{23}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(412316860416*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (1484626111.*R.^{24}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(4947802324992*(1 + Z^4/4 + Z^4/64)^4) + \\
& (21031.*R.^{24}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(68719476736*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (10718225.*R.^{25}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(4947802324992*(1 + Z^4/4 + Z^4/64)^4) + \\
& (33848465467.*R.^{26}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(422212465065984*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (272987.*R.^{26}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(8796093022208*(1 + Z^4/4 + Z^4/64)^4) + \\
& (11158205.*R.^{27}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(39582418599936*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (24750045961.*R.^{28}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1266637395197952*(1 + Z^4/4 + Z^4/64)^4) + \\
& (11305.*R.^{28}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(4398046511104*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (6450277.*R.^{29}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(211106232532992*(1 + Z^4/4 + Z^4/64)^4) + \\
& (59064594011.*R.^{30}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(13510798882111488*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (24225.*R.^{30}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(140737488355328*(1 + Z^4/4 + Z^4/64)^4) + \\
& (4624109.*R.^{31}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1688849860263936*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (36553306561.*R.^{32}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(40532396646334464*(1 + Z^4/4 + Z^4/64)^4) + \\
& (323.*R.^{32}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(35184372088832*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (679915.*R.^{33}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(3377699720527872*(1 + Z^4/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^{34}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(6917529027641081856*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(72057594037927936*(1 + Z^4/4 + Z^4/64)^4) + \\
& (108205.*R.^{35}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(9007199254740992*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (105030792781.*R.^{36}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(3458764513820540928*(1 + Z^4/4 + Z^4/64)^4) + \\
& (855.*R.^{36}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(72057594037927936*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (990641.*R.^{37}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1729382256910270464*(1 + Z^4/4 + Z^4/64)^4) + \\
& (548568674633.*R.^{38}.*R.*Z^4*S^2*Z^4*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^4/4 + Z^4/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(6917529027641081856*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (294785.*R.^{39}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(13835058055282163712*(1 + Z^4/4 + Z^4/64)^4) + \\
& (10322387501.*R.^{40}.*R.*Z^4*S^2*Z^4*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^4/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(6917529027641081856*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (32965.*R.^{41}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(55340232221128654848*(1 + Z^4/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*R.*Z^4*S^2*Z^4*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^4/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(295147905179352825856*(1 + Z^4/4 + Z^4/64)^4) + \dots \\
& (15635.*R.^{43}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(1328165573307087716352*(1 + Z^4/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*R.*Z^4*S^2*Z^4*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^4/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z^4*S^2*Z^4*(S_v)^2)/(21250649172913403461632*(1 + Z^4/4 + Z^4/64)^4) + \dots
\end{aligned}$$

$(2057042720599.*R.^{46}*S^2*Z^4^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(49.*R.^{47}.*R.*Z^4*S^2*Z^4^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^4^2/4 + Z^4^4/64)^4) +$
 $(24026340573.*R.^{48}*S^2*Z^4^{46}*(S_v)^2)/\dots$
 $(151115727451828646838272*(1 + Z^4^2/4 + Z^4^4/64)^4) +$
 $(5273670271697.*R.^{50}*S^2*Z^4^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(37823055319.*R.^{52}*S^2*Z^4^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(31266829573.*R.^{54}*S^2*Z^4^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(305764487.*R.^{56}*S^2*Z^4^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^4^2/4 + Z^4^4/64)^4) +$
 \dots
 $(155671821505.*R.^{58}*S^2*Z^4^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(8605263625.*R.^{60}*S^2*Z^4^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(4487015167.*R.^{62}*S^2*Z^4^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(64197131.*R.^{64}*S^2*Z^4^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(7366421503.*R.^{66}*S^2*Z^4^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(118374655.*R.^{68}*S^2*Z^4^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(103217975.*R.^{70}*S^2*Z^4^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(1169089.*R.^{72}*S^2*Z^4^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(16453715.*R.^{74}*S^2*Z^4^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(234365.*R.^{76}*S^2*Z^4^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(77905.*R.^{78}*S^2*Z^4^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(175.*R.^{80}*S^2*Z^4^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^4^2/4 + Z^4^4/64)^4) + \dots$
 $(49.*R.^{82}*S^2*Z^4^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^4^2/4 + Z^4^4/64)^4);$

Ns4=Nf4+Nc+Nr4;

Phi4=Nf4./[Nc+Nr4];

Be4=1./[1+Phi4];

Gf4=Nf4./Ns4;

Gr4=[Nr4]./Ns4;

Nh4=Nc+Nr4;

Z5=15;

Nf5=Br*[(Z5^2).*exp(-2.*R.*Z5)+(Z5^2)*exp(-2*Z5)-2*Z5^2.*exp(-Z5-R.*Z5)];

Nr5=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z5^2/4 + Z5^4/64)^2)+
 $(R.^2.*R.*Z5^2*S^2*(S_v))/(4*(1 + Z5^2/4 + Z5^4/64)^2) - \dots$

$(43.*R.^4*S^2*Z5^2*(S_v))/(384*(1 + Z5^2/4 + Z5^4/64)^2) \dots$

+ $(5.*R.^5.*R.*Z5*S^2*Z5^3*(S_v))/(32*(1 + Z5^2/4 + Z5^4/64)^2) +$

$(407.*R.^6*S^2*Z5^4*(S_v))/(4096*(1 + Z5^2/4 + Z5^4/64)^2) + \dots$

$$\begin{aligned}
& (7.*R.^7.*R.*Z5^*S^2*Z5^5*(S_v))/(768*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (539.*R.^8*S^2*Z5^6*(S_v))/(4096*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (85225.*R.^10*S^2*Z5^8*(S_v))/(1572864*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (6487.*R.^12*S^2*Z5^10*(S_v))/(393216*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (17773.*R.^14*S^2*Z5^12*(S_v))/(4194304*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (2011.*R.^16*S^2*Z5^14*(S_v))/(2097152*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (206775.*R.^18*S^2*Z5^16*(S_v))/(1073741824*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (108275.*R.^20*S^2*Z5^18*(S_v))/(3221225472*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (512435.*R.^22*S^2*Z5^20*(S_v))/(103079215104*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (21031.*R.^24*S^2*Z5^22*(S_v))/(34359738368*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (272987.*R.^26*S^2*Z5^24*(S_v))/(4398046511104*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (11305.*R.^28*S^2*Z5^26*(S_v))/(2199023255552*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (24225.*R.^30*S^2*Z5^28*(S_v))/(70368744177664*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (323.*R.^32*S^2*Z5^30*(S_v))/(17592186044416*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (27455.*R.^34*S^2*Z5^32*(S_v))/(36028797018963968*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (855.*R.^36*S^2*Z5^34*(S_v))/(36028797018963968*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (1805.*R.^38*S^2*Z5^36*(S_v))/(3458764513820540928*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (25.*R.^40*S^2*Z5^38*(S_v))/(3458764513820540928*(1 + Z5^2/4 + Z5^4/64)^2) + ... \\
& (7.*R.^42*S^2*Z5^40*(S_v))/(147573952589676412928*(1 + Z5^2/4 + Z5^4/64)^2) + \\
& (625.*R.^2*S^2*(S_v)^2)/(147456*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (25.*R.^2.*R.*Z5^2*S^2*(S_v)^2)/(768*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (R.^2.*R.*Z5^4*S^2*(S_v)^2)/(16*(1 + Z5^2/4 + Z5^4/64)^4) - ... \\
& (1075.*R.^4*S^2*Z5^2*(S_v)^2)/(73728*(1 + Z5^2/4 + Z5^4/64)^4) - \\
& (43.*R.^4.*R.*Z5^2*S^2*Z5^2*(S_v)^2)/(768*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (125.*R.^5.*R.*Z5^2*S^2*Z5^3*(S_v)^2)/(6144*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (5.*R.^5.*R.*Z5^3*S^2*Z5^3*(S_v)^2)/(64*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (60109.*R.^6*S^2*Z5^4*(S_v)^2)/(2359296*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (407.*R.^6.*R.*Z5^2*S^2*Z5^4*(S_v)^2)/(8192*(1 + Z5^2/4 + Z5^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z5^2*S^2*Z5^5*(S_v)^2)/(147456*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (7.*R.^7.*R.*Z5^3*S^2*Z5^5*(S_v)^2)/(1536*(1 + Z5^2/4 + Z5^4/64)^4) - ... \\
& (671.*R.^8*S^2*Z5^6*(S_v)^2)/(131072*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (739.*R.^8.*R.*Z5^2*S^2*Z5^6*(S_v)^2)/(8192*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z5^2*S^2*Z5^7*(S_v)^2)/(589824*(1 + Z5^2/4 + Z5^4/64)^4) - \\
& (3787661.*R.^10*S^2*Z5^8*(S_v)^2)/(301989888*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z5^2*S^2*Z5^8*(S_v)^2)/(1048576*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (67529.*R.^11.*R.*Z5^2*S^2*Z5^9*(S_v)^2)/(1572864*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (1627151.*R.^12*S^2*Z5^10*(S_v)^2)/(100663296*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (19657.*R.^12.*R.*Z5^2*S^2*Z5^10*(S_v)^2)/(2359296*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z5^2*S^2*Z5^11*(S_v)^2)/(25165824*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (241027273.*R.^14*S^2*Z5^12*(S_v)^2)/(9663676416*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z5^2*S^2*Z5^12*(S_v)^2)/(8388608*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z5^2*S^2*Z5^13*(S_v)^2)/(603979776*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (53842355.*R.^16*S^2*Z5^14*(S_v)^2)/(3221225472*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (2011.*R.^16.*R.*Z5^2*S^2*Z5^14*(S_v)^2)/(4194304*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z5^2*S^2*Z5^15*(S_v)^2)/(603979776*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (19618549477.*R.^18*S^2*Z5^16*(S_v)^2)/(2473901162496*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z5^2*S^2*Z5^16*(S_v)^2)/(2147483648*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (607051.*R.^19.*R.*Z5^2*S^2*Z5^17*(S_v)^2)/(1610612736*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (944668661.*R.^20*S^2*Z5^18*(S_v)^2)/(309237645312*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (108275.*R.^20.*R.*Z5^2*S^2*Z5^18*(S_v)^2)/(6442450944*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z5^2*S^2*Z5^19*(S_v)^2)/(51539607552*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (3348433219.*R.^22*S^2*Z5^20*(S_v)^2)/(3298534883328*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z5^2*S^2*Z5^20*(S_v)^2)/(206158430208*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z5^2*S^2*Z5^21*(S_v)^2)/(412316860416*(1 + Z5^2/4 + Z5^4/64)^4) + ... \\
& (1484626111.*R.^24*S^2*Z5^22*(S_v)^2)/(4947802324992*(1 + Z5^2/4 + Z5^4/64)^4) + \\
& (21031.*R.^24.*R.*Z5^2*S^2*Z5^22*(S_v)^2)/(68719476736*(1 + Z5^2/4 + Z5^4/64)^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (10718225 \cdot R^{25} \cdot R \cdot Z^5 S^2 Z^5^{23} (S_v)^2) / (4947802324992 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (33848465467 \cdot R^{26} S^2 Z^5^{24} (S_v)^2) / (422212465065984 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (272987 \cdot R^{26} \cdot R \cdot Z^5 S^2 Z^5^{24} (S_v)^2) / (8796093022208 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (11158205 \cdot R^{27} \cdot R \cdot Z^5 S^2 Z^5^{25} (S_v)^2) / (39582418599936 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (24750045961 \cdot R^{28} S^2 Z^5^{26} (S_v)^2) / (1266637395197952 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (11305 \cdot R^{28} \cdot R \cdot Z^5 S^2 Z^5^{26} (S_v)^2) / (4398046511104 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (6450277 \cdot R^{29} \cdot R \cdot Z^5 S^2 Z^5^{27} (S_v)^2) / (211106232532992 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (59064594011 \cdot R^{30} S^2 Z^5^{28} (S_v)^2) / (13510798882111488 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (24225 \cdot R^{30} \cdot R \cdot Z^5 S^2 Z^5^{28} (S_v)^2) / (140737488355328 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (4624109 \cdot R^{31} \cdot R \cdot Z^5 S^2 Z^5^{29} (S_v)^2) / (1688849860263936 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (36553306561 \cdot R^{32} S^2 Z^5^{30} (S_v)^2) / (40532396646334464 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (323 \cdot R^{32} \cdot R \cdot Z^5 S^2 Z^5^{30} (S_v)^2) / (35184372088832 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (679915 \cdot R^{33} \cdot R \cdot Z^5 S^2 Z^5^{31} (S_v)^2) / (3377699720527872 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (1189947216611 \cdot R^{34} S^2 Z^5^{32} (S_v)^2) / (6917529027641081856 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (27455 \cdot R^{34} \cdot R \cdot Z^5 S^2 Z^5^{32} (S_v)^2) / (72057594037927936 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (108205 \cdot R^{35} \cdot R \cdot Z^5 S^2 Z^5^{33} (S_v)^2) / (9007199254740992 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (105030792781 \cdot R^{36} S^2 Z^5^{34} (S_v)^2) / (3458764513820540928 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (855 \cdot R^{36} \cdot R \cdot Z^5 S^2 Z^5^{34} (S_v)^2) / (72057594037927936 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (990641 \cdot R^{37} \cdot R \cdot Z^5 S^2 Z^5^{35} (S_v)^2) / (1729382256910270464 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (548568674633 \cdot R^{38} S^2 Z^5^{36} (S_v)^2) / \dots \\
& (110680464442257309696 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (1805 \cdot R^{38} \cdot R \cdot Z^5 S^2 Z^5^{36} (S_v)^2) / (6917529027641081856 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (294785 \cdot R^{39} \cdot R \cdot Z^5 S^2 Z^5^{37} (S_v)^2) / (13835058055282163712 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (10322387501 \cdot R^{40} S^2 Z^5^{38} (S_v)^2) / \dots \\
& (13835058055282163712 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (25 \cdot R^{40} \cdot R \cdot Z^5 S^2 Z^5^{38} (S_v)^2) / (6917529027641081856 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (32965 \cdot R^{41} \cdot R \cdot Z^5 S^2 Z^5^{39} (S_v)^2) / (55340232221128654848 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (1462601471251 \cdot R^{42} S^2 Z^5^{40} (S_v)^2) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (7 \cdot R^{42} \cdot R \cdot Z^5 S^2 Z^5^{40} (S_v)^2) / (295147905179352825856 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (15635 \cdot R^{43} \cdot R \cdot Z^5 S^2 Z^5^{41} (S_v)^2) / (1328165573307087716352 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (185335180013 \cdot R^{44} S^2 Z^5^{42} (S_v)^2) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (3115 \cdot R^{45} \cdot R \cdot Z^5 S^2 Z^5^{43} (S_v)^2) / (21250649172913403461632 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (2057042720599 \cdot R^{46} S^2 Z^5^{44} (S_v)^2) / (1360041547066457821544448 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (49 \cdot R^{47} \cdot R \cdot Z^5 S^2 Z^5^{45} (S_v)^2) / (56668397794435742564352 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (24026340573 \cdot R^{48} S^2 Z^5^{46} (S_v)^2) / \dots \\
& (151115727451828646838272 \cdot (1 + Z^5/2 + Z^5/64)^4) + \\
& (5273670271697 \cdot R^{50} S^2 Z^5^{48} (S_v)^2) / (348170636049013202315378688 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (37823055319 \cdot R^{52} S^2 Z^5^{50} (S_v)^2) / (29014219670751100192948224 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (31266829573 \cdot R^{54} S^2 Z^5^{52} (S_v)^2) / (309485009821345068724781056 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (305764487 \cdot R^{56} S^2 Z^5^{54} (S_v)^2) / (43521329506126650289422336 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (155671821505 \cdot R^{58} S^2 Z^5^{56} (S_v)^2) / (356526731314189519170947776512 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (8605263625 \cdot R^{60} S^2 Z^5^{58} (S_v)^2) / (356526731314189519170947776512 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (4487015167 \cdot R^{62} S^2 Z^5^{60} (S_v)^2) / (3802951800684688204490109616128 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots \\
& (64197131 \cdot R^{64} S^2 Z^5^{62} (S_v)^2) / (1267650600228229401496703205376 \cdot (1 + Z^5/2 + Z^5/64)^4) + \dots
\end{aligned}$$

```

(7366421503.*R.^66*S^2*Z5^64*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(118374655.*R.^68*S^2*Z5^66*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(103217975.*R.^70*S^2*Z5^68*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(1169089.*R.^72*S^2*Z5^70*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(16453715.*R.^74*S^2*Z5^72*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(234365.*R.^76*S^2*Z5^74*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(77905.*R.^78*S^2*Z5^76*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(175.*R.^80*S^2*Z5^78*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z5^2/4 +
Z5^4/64)^4) + ...
(49.*R.^82*S^2*Z5^80*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z5^2/4 +
Z5^4/64)^4);

```

```

Ns5=Nf5+Nc+Nr5;
Phi5=Nf5./[Nc+Nr5];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gr5=[Nr5]./Ns5;
Nh5=Nc+Nr5;

```

```

plot(R,Ns1,'b',R,Ns2,'g',R,Ns3,'r',R,Ns4,'k',R,Ns5,'m')

```

```

% plot(R,Be1,'b',R,Be2,'g',R,Be3,'r',R,Be4,'k',R,Be5,'m')

```

```

% plot(R,Phi1,'b',R,Phi2,'g',R,Phi3,'r',R,Phi4,'k',R,Phi5,'m')

```

```

% plot(R,Gf1,'b',R,Gf2,'g',R,Gf3,'r',R,Gf4,'k',R,Gf5,'m')

```

```

% plot(R,Gr1,'b',R,Gr2,'g',R,Gr3,'r',R,Gr4,'k',R,Gr5,'m')

```

```

% plot(R,Nf1,'b',R,Nf2,'g',R,Nf3,'r',R,Nf4,'k',R,Nf5,'m')

```

```

% plot(R,Nh1,'b',R,Nh2,'g',R,Nh3,'r',R,Nh4,'k',R,Nh5,'m')

```

```

% % % % plot(Nh1,Nf1,'b',Nh2,Nf2,'g',Nh3,Nf3,'r',Nh4,Nf4,'k',Nh5,Nf5,'m')

```

PLOTTOOLS ON

2.3. Distribution of $N_S, Be, \Phi, G_F, G_R, N_C$ and N_H versus Y for a range of Pe

and set of S, S_v, Z & Br

```
S=1; S_v=1; Z=1; Br=1;
% S=5; S_v=0.75; Z=7.5; Br=0.4;
% % % % S=2; S_v=1; Z=5; Br=0.2;
% % % % S=25; S_v=15; Z=10; Br=0.4;
% % % % S=20; S_v=2; Z=2.5; Br=0.6;
% % % % S=10; S_v=25; Z=20; Br=0.5;
```

```
q=1.86;
s=1;
Dh=250*10^-6;
R=0.005:1;
```

```
Nf=Br*[(1024.*R.^2.*Z^4 + 256.*R.^4.*Z^6 + 16.*R.^6.*Z^8)./(4096 + 2048*Z^2 + 384*Z^4 + 32*Z^6
+ Z^8)];
```

```
Nr=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)+
(R.^2.*R.*Z^2*S^2*(S_v))/(4*(1 + Z^2/4 + Z^4/64)^2) -...
(43.*R.^4*S^2*Z^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)...
+ (5.*R.^5.*R.*Z*S^2*Z^3*(S_v))/(32*(1 + Z^2/4 + Z^4/64)^2)+ (407.*R.^6*S^2*Z^4*(S_v))/(4096*(1
+ Z^2/4 + Z^4/64)^2) + ...
(7.*R.^7.*R.*Z*S^2*Z^5*(S_v))/(768*(1 + Z^2/4 + Z^4/64)^2) + (539.*R.^8*S^2*Z^6*(S_v))/(4096*(1
+ Z^2/4 + Z^4/64)^2) + ...
(85225.*R.^10*S^2*Z^8*(S_v))/(1572864*(1 + Z^2/4 + Z^4/64)^2) +
(6487.*R.^12*S^2*Z^10*(S_v))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ...
(17773.*R.^14*S^2*Z^12*(S_v))/(4194304*(1 + Z^2/4 + Z^4/64)^2) +
(2011.*R.^16*S^2*Z^14*(S_v))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...
(206775.*R.^18*S^2*Z^16*(S_v))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) +
(108275.*R.^20*S^2*Z^18*(S_v))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) +...
(512435.*R.^22*S^2*Z^20*(S_v))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) +
(21031.*R.^24*S^2*Z^22*(S_v))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) +...
(272987.*R.^26*S^2*Z^24*(S_v))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) +
(11305.*R.^28*S^2*Z^26*(S_v))/(2199023255552*(1 + Z^2/4 + Z^4/64)^2) + ...
(24225.*R.^30*S^2*Z^28*(S_v))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) +
(323.*R.^32*S^2*Z^30*(S_v))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...
(27455.*R.^34*S^2*Z^32*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +
(855.*R.^36*S^2*Z^34*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...
(1805.*R.^38*S^2*Z^36*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +
(25.*R.^40*S^2*Z^38*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...
(7.*R.^42*S^2*Z^40*(S_v))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +
(625.*R.^2*S^2*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ...
(25.*R.^2.*R.*Z^2*S^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + (R.^2.*R.*Z^4*S^2*(S_v)^2)/(16*(1
+ Z^2/4 + Z^4/64)^4) - ...
(1075.*R.^4*S^2*Z^2*(S_v)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) -
(43.*R.^4.*R.*Z^2*S^2*Z^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ...
(125.*R.^5.*R.*Z*S^2*Z^3*(S_v)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) +
(5.*R.^5.*R.*Z^3*S^2*Z^3*(S_v)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ...
```

$$\begin{aligned}
& (60109.*R.^6*S^2*Z^4*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (407.*R.^6.*R.*Z^2*S^2*Z^4*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z^2*S^2*Z^5*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^7.*R.*Z^3*S^2*Z^5*(S_v)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (671.*R.^8*S^2*Z^6*(S_v)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) + \\
& (739.*R.^8.*R.*Z^2*S^2*Z^6*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z^2*S^2*Z^7*(S_v)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) - \\
& (3787661.*R.^10*S^2*Z^8*(S_v)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_v)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) + \\
& (67529.*R.^11.*R.*Z^2*S^2*Z^9*(S_v)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1627151.*R.^12*S^2*Z^10*(S_v)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19657.*R.^12.*R.*Z^2*S^2*Z^10*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z^2*S^2*Z^11*(S_v)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) + \\
& (241027273.*R.^14*S^2*Z^12*(S_v)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S^2*Z^12*(S_v)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z^2*S^2*Z^13*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (53842355.*R.^16*S^2*Z^14*(S_v)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^16.*R.*Z^2*S^2*Z^14*(S_v)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z^2*S^2*Z^15*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^18*S^2*Z^16*(S_v)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S^2*Z^16*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^19.*R.*Z^2*S^2*Z^17*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (944668661.*R.^20*S^2*Z^18*(S_v)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^20.*R.*Z^2*S^2*Z^18*(S_v)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z^2*S^2*Z^19*(S_v)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^22*S^2*Z^20*(S_v)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S^2*Z^20*(S_v)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z^2*S^2*Z^21*(S_v)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1484626111.*R.^24*S^2*Z^22*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^24.*R.*Z^2*S^2*Z^22*(S_v)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (10718225.*R.^25.*R.*Z^2*S^2*Z^23*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^26*S^2*Z^24*(S_v)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S^2*Z^24*(S_v)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^27.*R.*Z^2*S^2*Z^25*(S_v)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24750045961.*R.^28*S^2*Z^26*(S_v)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^28.*R.*Z^2*S^2*Z^26*(S_v)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (6450277.*R.^29.*R.*Z^2*S^2*Z^27*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^30*S^2*Z^28*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S^2*Z^28*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^31.*R.*Z^2*S^2*Z^29*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^32*S^2*Z^30*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^32.*R.*Z^2*S^2*Z^30*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^33.*R.*Z^2*S^2*Z^31*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^34*S^2*Z^32*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S^2*Z^32*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^35.*R.*Z^2*S^2*Z^33*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^36*S^2*Z^34*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^36.*R.*Z^2*S^2*Z^34*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^37.*R.*Z^2*S^2*Z^35*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^38*S^2*Z^36*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^38.*R.*Z^2*S^2*Z^36*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^39.*R.*Z^2*S^2*Z^37*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^40*S^2*Z^38*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^40.*R.*Z^2*S^2*Z^38*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (32965.*R.^{41}.*R.*Z*S^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1462601471251.*R.^{42}*S^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (185335180013.*R.^{44}*S^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (2057042720599.*R.^{46}*S^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& ... \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (24026340573.*R.^{48}*S^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5273670271697.*R.^{50}*S^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& + ... \\
& (37823055319.*R.^{52}*S^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& ... \\
& (31266829573.*R.^{54}*S^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& ... \\
& (305764487.*R.^{56}*S^2*Z^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (155671821505.*R.^{58}*S^2*Z^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (8605263625.*R.^{60}*S^2*Z^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (4487015167.*R.^{62}*S^2*Z^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (64197131.*R.^{64}*S^2*Z^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (7366421503.*R.^{66}*S^2*Z^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (118374655.*R.^{68}*S^2*Z^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (103217975.*R.^{70}*S^2*Z^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1169089.*R.^{72}*S^2*Z^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (16453715.*R.^{74}*S^2*Z^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (234365.*R.^{76}*S^2*Z^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (77905.*R.^{78}*S^2*Z^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (175.*R.^{80}*S^2*Z^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (49.*R.^{82}*S^2*Z^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^{2/4} + Z^{4/64})^4);
\end{aligned}$$

$$\begin{aligned}
& Pe1=2; \\
& Nc1=[1./Pe1^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh]; \\
& Ns1=Nf+Nc1+Nr; \\
& Phi1=Nf./[Nc1+Nr]; \\
& Be1=1./[1+Phi1]; \\
& Gf1=Nf./Ns1; \\
& Gr1=[Nr]./Ns1; \\
& Nh1=Nc1+Nr;
\end{aligned}$$

```

Pe2=4;
Nc2=[1./Pe2^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns2=Nf+Nc2+Nr;
Phi2=Nf./[Nc2+Nr];
Be2=1./[1+Phi2];
Gf2=Nf./Ns2;
Gr2=[Nr]./Ns2;
Nh2=Nc2+Nr;

```

```

Pe3=6;
Nc3=[1./Pe3^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns3=Nf+Nc3+Nr;
Phi3=Nf./[Nc3+Nr];
Be3=1./[1+Phi3];
Gf3=Nf./Ns3;
Gr3=[Nr]./Ns3;
Nh3=Nc3+Nr;

```

```

Pe4=8;
Nc4=[1./Pe4^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns4=Nf+Nc4+Nr;
Phi4=Nf./[Nc4+Nr];
Be4=1./[1+Phi4];
Gf4=Nf./Ns4;
Gr4=[Nr]./Ns4;
Nh4=Nc4+Nr;

```

```

Pe5=10;
Nc5=[1./Pe5^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];
Ns5=Nf+Nc5+Nr;
Phi5=Nf./[Nc5+Nr];
Be5=1./[1+Phi5];
Gf5=Nf./Ns5;
Gr5=[Nr]./Ns5;
Nh5=Nc5+Nr;

```

```

plot(R,Ns1,'b',R,Ns2,'g',R,Ns3,'r',R,Ns4,'k',R,Ns5,'m')

% plot(R,Be1,'b',R,Be2,'g',R,Be3,'r',R,Be4,'k',R,Be5,'m')

% plot(R,Phi1,'b',R,Phi2,'g',R,Phi3,'r',R,Phi4,'k',R,Phi5,'m')

% plot(R,Gf1,'b',R,Gf2,'g',R,Gf3,'r',R,Gf4,'k',R,Gf5,'m')

% plot(R,Gr1,'b',R,Gr2,'g',R,Gr3,'r',R,Gr4,'k',R,Gr5,'m')

% plot(R,Nc1,'b',R,Nc2,'g',R,Nc3,'r',R,Nc4,'k',R,Nc5,'m')

% plot(R,Nh1,'b',R,Nh2,'g',R,Nh3,'r',R,Nh4,'k',R,Nh5,'m')

```

PLOTTOOLS ON

2.4. Distribution of $N_S, Be, \Phi, G_F, G_R, N_F$ and N_H versus Y for a range of S

and set of S_v, Z, Br & Pe

$S_v=1; Z=1; Br=1; Pe=10;$

$\% S_v=2.5; Z=2; Br=0.5; Pe=5;$

$\% \% \% \% Z=4; S_v=10; Br=0.6; Pe=8;$

$\% \% \% \% Z=5; S_v=0.75; Br=0.2; Pe=2;$

$\% \% \% \% Z=10; S_v=5; Br=1; Pe=7.5;$

$\% \% \% \% Z=20; S_v=15; Br=0.9; Pe=10;$

$q=1.86;$

$s=1;$

$Dh=250 \times 10^{-6};$

$R=0.005:1;$

$Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];$

$S1=1;$

$Nf1=Br*[(Z^2).*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)];$

$Nr1=(R.^2*S1^2)/4 + (25.*R.^2*S1^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)+$
 $(R.^2.*R.*Z^2*S1^2*(S_v))/(4*(1 + Z^2/4 + Z^4/64)^2) - ...$
 $(43.*R.^4*S1^2*Z^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2) ...$
 $+ (5.*R.^5.*R.*Z*S1^2*Z^3*(S_v))/(32*(1 + Z^2/4 + Z^4/64)^2)+$
 $(407.*R.^6*S1^2*Z^4*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^7.*R.*Z*S1^2*Z^5*(S_v))/(768*(1 + Z^2/4 + Z^4/64)^2) +$
 $(539.*R.^8*S1^2*Z^6*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(85225.*R.^10*S1^2*Z^8*(S_v))/(1572864*(1 + Z^2/4 + Z^4/64)^2) +$
 $(6487.*R.^12*S1^2*Z^10*(S_v))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(17773.*R.^14*S1^2*Z^12*(S_v))/(4194304*(1 + Z^2/4 + Z^4/64)^2) +$
 $(2011.*R.^16*S1^2*Z^14*(S_v))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(206775.*R.^18*S1^2*Z^16*(S_v))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) +$
 $(108275.*R.^20*S1^2*Z^18*(S_v))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(512435.*R.^22*S1^2*Z^20*(S_v))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(21031.*R.^24*S1^2*Z^22*(S_v))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(272987.*R.^26*S1^2*Z^24*(S_v))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(11305.*R.^28*S1^2*Z^26*(S_v))/(2199023255552*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(24225.*R.^30*S1^2*Z^28*(S_v))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) +$
 $(323.*R.^32*S1^2*Z^30*(S_v))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(27455.*R.^34*S1^2*Z^32*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +$
 $(855.*R.^36*S1^2*Z^34*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(1805.*R.^38*S1^2*Z^36*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(25.*R.^40*S1^2*Z^38*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^42*S1^2*Z^40*(S_v))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(625.*R.^2*S1^2*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(25.*R.^2.*R.*Z^2*S1^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) +$
 $(R.^2.*R.*Z^4*S1^2*(S_v)^2)/(16*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(1075.*R.^4*S1^2*Z^2*(S_v)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) -$
 $(43.*R.^4.*R.*Z^2*S1^2*Z^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ...$

$$\begin{aligned}
& (125.*R.^5.*R.*Z*S1^2*Z^3*(S_v)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5.*R.^5.*R.*Z^3*S1^2*Z^3*(S_v)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (60109.*R.^6.*S1^2*Z^4*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (407.*R.^6.*R.*Z^2*S1^2*Z^4*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z*S1^2*Z^5*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^7.*R.*Z^3*S1^2*Z^5*(S_v)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (671.*R.^8.*S1^2*Z^6*(S_v)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) + \\
& (739.*R.^8.*R.*Z^2*S1^2*Z^6*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z*S1^2*Z^7*(S_v)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) - \\
& (3787661.*R.^10.*S1^2*Z^8*(S_v)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S1^2*Z^8*(S_v)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) + \\
& (67529.*R.^11.*R.*Z*S1^2*Z^9*(S_v)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1627151.*R.^12.*S1^2*Z^10*(S_v)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19657.*R.^12.*R.*Z^2*S1^2*Z^10*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z*S1^2*Z^11*(S_v)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) + \\
& (241027273.*R.^14.*S1^2*Z^12*(S_v)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S1^2*Z^12*(S_v)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z*S1^2*Z^13*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (53842355.*R.^16.*S1^2*Z^14*(S_v)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^16.*R.*Z^2*S1^2*Z^14*(S_v)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z*S1^2*Z^15*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^18.*S1^2*Z^16*(S_v)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S1^2*Z^16*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^19.*R.*Z*S1^2*Z^17*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (944668661.*R.^20.*S1^2*Z^18*(S_v)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^20.*R.*Z^2*S1^2*Z^18*(S_v)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z*S1^2*Z^19*(S_v)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^22.*S1^2*Z^20*(S_v)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S1^2*Z^20*(S_v)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z*S1^2*Z^21*(S_v)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1484626111.*R.^24.*S1^2*Z^22*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^24.*R.*Z^2*S1^2*Z^22*(S_v)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (10718225.*R.^25.*R.*Z*S1^2*Z^23*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^26.*S1^2*Z^24*(S_v)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S1^2*Z^24*(S_v)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^27.*R.*Z*S1^2*Z^25*(S_v)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24750045961.*R.^28.*S1^2*Z^26*(S_v)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^28.*R.*Z^2*S1^2*Z^26*(S_v)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (6450277.*R.^29.*R.*Z*S1^2*Z^27*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^30.*S1^2*Z^28*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S1^2*Z^28*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^31.*R.*Z*S1^2*Z^29*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^32.*S1^2*Z^30*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^32.*R.*Z^2*S1^2*Z^30*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^33.*R.*Z*S1^2*Z^31*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^34.*S1^2*Z^32*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S1^2*Z^32*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^35.*R.*Z*S1^2*Z^33*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^36.*S1^2*Z^34*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^36.*R.*Z^2*S1^2*Z^34*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^37.*R.*Z*S1^2*Z^35*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^38.*S1^2*Z^36*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^38.*R.*Z^2*S1^2*Z^36*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^39.*R.*Z*S1^2*Z^37*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^40.*S1^2*Z^38*(S_v)^2)/...
\end{aligned}$$

$$\begin{aligned}
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S1^2*Z^38*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (32965.*R.^{41}.*R.*Z*S1^2*Z^39*(S_v)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*S1^2*Z^40*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S1^2*Z^40*(S_v)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (15635.*R.^{43}.*R.*Z*S1^2*Z^41*(S_v)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*S1^2*Z^42*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S1^2*Z^43*(S_v)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2057042720599.*R.^{46}.*S1^2*Z^44*(S_v)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (49.*R.^{47}.*R.*Z*S1^2*Z^45*(S_v)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*S1^2*Z^46*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^{50}.*S1^2*Z^48*(S_v)^2)/(348170636049013202315378688*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (37823055319.*R.^{52}.*S1^2*Z^50*(S_v)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (31266829573.*R.^{54}.*S1^2*Z^52*(S_v)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (305764487.*R.^{56}.*S1^2*Z^54*(S_v)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (155671821505.*R.^{58}.*S1^2*Z^56*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (8605263625.*R.^{60}.*S1^2*Z^58*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (4487015167.*R.^{62}.*S1^2*Z^60*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (64197131.*R.^{64}.*S1^2*Z^62*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (7366421503.*R.^{66}.*S1^2*Z^64*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (118374655.*R.^{68}.*S1^2*Z^66*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (103217975.*R.^{70}.*S1^2*Z^68*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (1169089.*R.^{72}.*S1^2*Z^70*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (16453715.*R.^{74}.*S1^2*Z^72*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (234365.*R.^{76}.*S1^2*Z^74*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (77905.*R.^{78}.*S1^2*Z^76*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (175.*R.^{80}.*S1^2*Z^78*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (49.*R.^{82}.*S1^2*Z^80*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 + \\
& Z^4/64)^4);
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf1 + Nc + Nr1; \\
Phi1 &= Nf1./[Nc + Nr1]; \\
Be1 &= 1./[1 + Phi1]; \\
Gf1 &= Nf1./Ns1; \\
Gr1 &= [Nr1]./Ns1; \\
Nh1 &= Nc + Nr1;
\end{aligned}$$

$$\begin{aligned}
& S2=4; \\
& Nf2=Br[(Z^2).exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)]; \\
& Nr2=(R.^2*S2^2)/4 + (25.*R.^2*S2^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)+ \\
& (R.^2.*R.*Z^2*S2^2*(S_v))/(4*(1 + Z^2/4 + Z^4/64)^2) - ... \\
& (43.*R.^4*S2^2*Z^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)... \\
& + (5.*R.^5.*R.*Z*S2^2*Z^3*(S_v))/(32*(1 + Z^2/4 + Z^4/64)^2)+ \\
& (407.*R.^6*S2^2*Z^4*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (7.*R.^7.*R.*Z*S2^2*Z^5*(S_v))/(768*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (539.*R.^8*S2^2*Z^6*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (85225.*R.^10*S2^2*Z^8*(S_v))/(1572864*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (6487.*R.^12*S2^2*Z^10*(S_v))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (17773.*R.^14*S2^2*Z^12*(S_v))/(4194304*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (2011.*R.^16*S2^2*Z^14*(S_v))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (206775.*R.^18*S2^2*Z^16*(S_v))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (108275.*R.^20*S2^2*Z^18*(S_v))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (512435.*R.^22*S2^2*Z^20*(S_v))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (21031.*R.^24*S2^2*Z^22*(S_v))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (272987.*R.^26*S2^2*Z^24*(S_v))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (11305.*R.^28*S2^2*Z^26*(S_v))/(2199023255552*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (24225.*R.^30*S2^2*Z^28*(S_v))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (323.*R.^32*S2^2*Z^30*(S_v))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (27455.*R.^34*S2^2*Z^32*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (855.*R.^36*S2^2*Z^34*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (1805.*R.^38*S2^2*Z^36*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (25.*R.^40*S2^2*Z^38*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (7.*R.^42*S2^2*Z^40*(S_v))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (625.*R.^2*S2^2*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (25.*R.^2.*R.*Z^2*S2^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (R.^2.*R.*Z^4*S2^2*(S_v)^2)/(16*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (1075.*R.^4*S2^2*Z^2*(S_v)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (43.*R.^4.*R.*Z^2*S2^2*Z^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (125.*R.^5.*R.*Z*S2^2*Z^3*(S_v)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (5.*R.^5.*R.*Z^3*S2^2*Z^3*(S_v)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (60109.*R.^6*S2^2*Z^4*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (407.*R.^6.*R.*Z^2*S2^2*Z^4*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z*S2^2*Z^5*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (7.*R.^7.*R.*Z^3*S2^2*Z^5*(S_v)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (671.*R.^8*S2^2*Z^6*(S_v)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (739.*R.^8.*R.*Z^2*S2^2*Z^6*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z*S2^2*Z^7*(S_v)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (3787661.*R.^10*S2^2*Z^8*(S_v)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S2^2*Z^8*(S_v)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (67529.*R.^11.*R.*Z*S2^2*Z^9*(S_v)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1627151.*R.^12*S2^2*Z^10*(S_v)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (19657.*R.^12.*R.*Z^2*S2^2*Z^10*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z*S2^2*Z^11*(S_v)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (241027273.*R.^14*S2^2*Z^12*(S_v)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S2^2*Z^12*(S_v)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (3710335.*R.^15.*R.*Z*S2^2*Z^13*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (53842355.*R.^16*S2^2*Z^14*(S_v)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2011.*R.^16.*R.*Z^2*S2^2*Z^14*(S_v)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z*S2^2*Z^15*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (19618549477.*R.^18*S2^2*Z^16*(S_v)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S2^2*Z^16*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (607051.*R.^19.*R.*Z*S2^2*Z^17*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (944668661.*R.^{20}*S^2*Z^{18}*(S_v)^2)/(309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^{20}.*R.*Z^2*S^2*Z^{18}*(S_v)^2)/(6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (4002553.*R.^{21}.*R.*Z*S^2*Z^{19}*(S_v)^2)/(51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^{22}*S^2*Z^{20}*(S_v)^2)/(3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (512435.*R.^{22}.*R.*Z^2*S^2*Z^{20}*(S_v)^2)/(206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^{23}.*R.*Z*S^2*Z^{21}*(S_v)^2)/(412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (1484626111.*R.^{24}*S^2*Z^{22}*(S_v)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^{24}.*R.*Z^2*S^2*Z^{22}*(S_v)^2)/(68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (10718225.*R.^{25}.*R.*Z*S^2*Z^{23}*(S_v)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^{26}*S^2*Z^{24}*(S_v)^2)/(422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (272987.*R.^{26}.*R.*Z^2*S^2*Z^{24}*(S_v)^2)/(8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^{27}.*R.*Z*S^2*Z^{25}*(S_v)^2)/(3958241859936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (24750045961.*R.^{28}*S^2*Z^{26}*(S_v)^2)/(1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^{28}.*R.*Z^2*S^2*Z^{26}*(S_v)^2)/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (6450277.*R.^{29}.*R.*Z*S^2*Z^{27}*(S_v)^2)/(211106232532992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (59064594011.*R.^{30}*S^2*Z^{28}*(S_v)^2)/(13510798882111488*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (24225.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v)^2)/(140737488355328*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (4624109.*R.^{31}.*R.*Z*S^2*Z^{29}*(S_v)^2)/(1688849860263936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (36553306561.*R.^{32}*S^2*Z^{30}*(S_v)^2)/(40532396646334464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (323.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v)^2)/(35184372088832*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (679915.*R.^{33}.*R.*Z*S^2*Z^{31}*(S_v)^2)/(3377699720527872*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1189947216611.*R.^{34}*S^2*Z^{32}*(S_v)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108205.*R.^{35}.*R.*Z*S^2*Z^{33}*(S_v)^2)/(9007199254740992*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (105030792781.*R.^{36}*S^2*Z^{34}*(S_v)^2)/(3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (855.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (990641.*R.^{37}.*R.*Z*S^2*Z^{35}*(S_v)^2)/(1729382256910270464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (548568674633.*R.^{38}*S^2*Z^{36}*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (294785.*R.^{39}.*R.*Z*S^2*Z^{37}*(S_v)^2)/(13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (10322387501.*R.^{40}*S^2*Z^{38}*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (32965.*R.^{41}.*R.*Z*S^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1462601471251.*R.^{42}*S^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (185335180013.*R.^{44}*S^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (2057042720599.*R.^{46}*S^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + \dots \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (24026340573.*R.^{48}*S^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5273670271697.*R.^{50}*S^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (37823055319.*R.^{52}*S^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& \dots \\
& (31266829573.*R.^{54}*S^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + \dots \\
& (305764487.*R.^{56}*S^2*Z^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (155671821505.*R.^{58}*S^2*Z^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + \dots
\end{aligned}$$

$(8605263625.*R.^{60}*S^2*Z^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(4487015167.*R.^{62}*S^2*Z^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(64197131.*R.^{64}*S^2*Z^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(7366421503.*R.^{66}*S^2*Z^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(118374655.*R.^{68}*S^2*Z^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(103217975.*R.^{70}*S^2*Z^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(1169089.*R.^{72}*S^2*Z^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(16453715.*R.^{74}*S^2*Z^{72}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(234365.*R.^{76}*S^2*Z^{74}*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(77905.*R.^{78}*S^2*Z^{76}*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(175.*R.^{80}*S^2*Z^{78}*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^{2/4} + Z^{4/64})^4) + \dots$
 $(49.*R.^{82}*S^2*Z^{80}*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^{2/4} + Z^{4/64})^4);$

$Ns2=Nf2+Nc+Nr2;$
 $\Phi2=Nf2./[Nc+Nr2];$
 $Be2=1./[1+\Phi2];$
 $Gf2=Nf2./Ns2;$
 $Gr2=[Nr2]./Ns2;$
 $Nh2=Nc+Nr2;$

$S3=8;$
 $Nf3=Br*[(Z^2)*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)];$
 $Nr3=(R.^2*S3^2)/4 + (25.*R.^2*S3^2*(S_v))/(384*(1 + Z^{2/4} + Z^{4/64})^2)+$
 $(R.^2.*R.*Z^2*S3^2*(S_v))/(4*(1 + Z^{2/4} + Z^{4/64})^2) - \dots$
 $(43.*R.^4*S3^2*Z^2*(S_v))/(384*(1 + Z^{2/4} + Z^{4/64})^2) \dots$
 $+ (5.*R.^5.*R.*Z*S3^2*Z^3*(S_v))/(32*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(407.*R.^6*S3^2*Z^4*(S_v))/(4096*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(7.*R.^7.*R.*Z*S3^2*Z^5*(S_v))/(768*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(539.*R.^8*S3^2*Z^6*(S_v))/(4096*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(85225.*R.^{10}*S3^2*Z^8*(S_v))/(1572864*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(6487.*R.^{12}*S3^2*Z^{10}*(S_v))/(393216*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(17773.*R.^{14}*S3^2*Z^{12}*(S_v))/(4194304*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(2011.*R.^{16}*S3^2*Z^{14}*(S_v))/(2097152*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(206775.*R.^{18}*S3^2*Z^{16}*(S_v))/(1073741824*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(108275.*R.^{20}*S3^2*Z^{18}*(S_v))/(3221225472*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(512435.*R.^{22}*S3^2*Z^{20}*(S_v))/(103079215104*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(21031.*R.^{24}*S3^2*Z^{22}*(S_v))/(34359738368*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(272987.*R.^{26}*S3^2*Z^{24}*(S_v))/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(11305.*R.^{28}*S3^2*Z^{26}*(S_v))/(2199023255552*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(24225.*R.^{30}*S3^2*Z^{28}*(S_v))/(70368744177664*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(323.*R.^{32}*S3^2*Z^{30}*(S_v))/(17592186044416*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(27455.*R.^{34}*S3^2*Z^{32}*(S_v))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$
 $(855.*R.^{36}*S3^2*Z^{34}*(S_v))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \dots$

$$\begin{aligned}
& (1805.*R.^{38}*S^3*Z^{36}*(S_v))/ (3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (25.*R.^{40}*S^3*Z^{38}*(S_v))/ (3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (7.*R.^{42}*S^3*Z^{40}*(S_v))/ (147573952589676412928*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (625.*R.^2*S^3*Z^2*(S_v)^2)/ (147456*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (25.*R.^2.*R.*Z^2*S^3*Z^2*(S_v)^2)/ (768*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (R.^2.*R.*Z^4*S^3*Z^2*(S_v)^2)/ (16*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (1075.*R.^4*S^3*Z^2*Z^2*(S_v)^2)/ (73728*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (43.*R.^4.*R.*Z^2*S^3*Z^2*Z^2*(S_v)^2)/ (768*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (125.*R.^5.*R.*Z^3*S^3*Z^3*(S_v)^2)/ (6144*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5.*R.^5.*R.*Z^3*S^3*Z^3*(S_v)^2)/ (64*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (60109.*R.^6*S^3*Z^4*(S_v)^2)/ (2359296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (407.*R.^6.*R.*Z^2*S^3*Z^4*(S_v)^2)/ (8192*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (4985.*R.^7.*R.*Z^3*S^3*Z^5*(S_v)^2)/ (147456*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^7.*R.*Z^3*S^3*Z^5*(S_v)^2)/ (1536*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (671.*R.^8*S^3*Z^6*(S_v)^2)/ (131072*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (739.*R.^8.*R.*Z^2*S^3*Z^6*(S_v)^2)/ (8192*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17111.*R.^9.*R.*Z^3*S^3*Z^7*(S_v)^2)/ (589824*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (3787661.*R.^10*S^3*Z^8*(S_v)^2)/ (301989888*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S^3*Z^8*(S_v)^2)/ (1048576*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (67529.*R.^11.*R.*Z^3*S^3*Z^9*(S_v)^2)/ (1572864*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1627151.*R.^12*S^3*Z^10*(S_v)^2)/ (100663296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19657.*R.^12.*R.*Z^2*S^3*Z^10*(S_v)^2)/ (2359296*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (486493.*R.^13.*R.*Z^3*S^3*Z^11*(S_v)^2)/ (25165824*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (241027273.*R.^14*S^3*Z^12*(S_v)^2)/ (9663676416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S^3*Z^12*(S_v)^2)/ (8388608*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3710335.*R.^15.*R.*Z^3*S^3*Z^13*(S_v)^2)/ (603979776*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (53842355.*R.^16*S^3*Z^14*(S_v)^2)/ (3221225472*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (2011.*R.^16.*R.*Z^2*S^3*Z^14*(S_v)^2)/ (4194304*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (981421.*R.^17.*R.*Z^3*S^3*Z^15*(S_v)^2)/ (603979776*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19618549477.*R.^18*S^3*Z^16*(S_v)^2)/ (2473901162496*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S^3*Z^16*(S_v)^2)/ (2147483648*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (607051.*R.^19.*R.*Z^3*S^3*Z^17*(S_v)^2)/ (1610612736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (944668661.*R.^20*S^3*Z^18*(S_v)^2)/ (309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^20.*R.*Z^2*S^3*Z^18*(S_v)^2)/ (6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (4002553.*R.^21.*R.*Z^3*S^3*Z^19*(S_v)^2)/ (51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^22*S^3*Z^20*(S_v)^2)/ (3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S^3*Z^20*(S_v)^2)/ (206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^23.*R.*Z^3*S^3*Z^21*(S_v)^2)/ (412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1484626111.*R.^24*S^3*Z^22*(S_v)^2)/ (4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^24.*R.*Z^2*S^3*Z^22*(S_v)^2)/ (68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (10718225.*R.^25.*R.*Z^3*S^3*Z^23*(S_v)^2)/ (4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^26*S^3*Z^24*(S_v)^2)/ (422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S^3*Z^24*(S_v)^2)/ (8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^27.*R.*Z^3*S^3*Z^25*(S_v)^2)/ (39582418599936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24750045961.*R.^28*S^3*Z^26*(S_v)^2)/ (1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^28.*R.*Z^2*S^3*Z^26*(S_v)^2)/ (4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (6450277.*R.^29.*R.*Z^3*S^3*Z^27*(S_v)^2)/ (211106232532992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (59064594011.*R.^30*S^3*Z^28*(S_v)^2)/ (13510798882111488*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S^3*Z^28*(S_v)^2)/ (140737488355328*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (4624109.*R.^31.*R.*Z^3*S^3*Z^29*(S_v)^2)/ (1688849860263936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (36553306561.*R.^32*S^3*Z^30*(S_v)^2)/ (40532396646334464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (323.*R.^32.*R.*Z^2*S^3*Z^30*(S_v)^2)/ (35184372088832*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (679915.*R.^33.*R.*Z^3*S^3*Z^31*(S_v)^2)/ (3377699720527872*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1189947216611.*R.^34*S^3*Z^32*(S_v)^2)/ (6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S^3*Z^32*(S_v)^2)/ (72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108205.*R.^35.*R.*Z^3*S^3*Z^33*(S_v)^2)/ (9007199254740992*(1 + Z^{2/4} + Z^{4/64})^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (105030792781 \cdot R.^{36} S^3 Z^{34} (S_v)^2) / (3458764513820540928 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (855 \cdot R.^{36} \cdot R \cdot Z^2 S^3 Z^{34} (S_v)^2) / (72057594037927936 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (990641 \cdot R.^{37} \cdot R \cdot Z S^3 Z^{35} (S_v)^2) / (1729382256910270464 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (548568674633 \cdot R.^{38} S^3 Z^{36} (S_v)^2) / \dots \\
& (110680464442257309696 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (1805 \cdot R.^{38} \cdot R \cdot Z^2 S^3 Z^{36} (S_v)^2) / (6917529027641081856 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (294785 \cdot R.^{39} \cdot R \cdot Z S^3 Z^{37} (S_v)^2) / (13835058055282163712 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (10322387501 \cdot R.^{40} S^3 Z^{38} (S_v)^2) / \dots \\
& (13835058055282163712 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (25 \cdot R.^{40} \cdot R \cdot Z^2 S^3 Z^{38} (S_v)^2) / (6917529027641081856 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (32965 \cdot R.^{41} \cdot R \cdot Z S^3 Z^{39} (S_v)^2) / (55340232221128654848 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (1462601471251 \cdot R.^{42} S^3 Z^{40} (S_v)^2) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (7 \cdot R.^{42} \cdot R \cdot Z^2 S^3 Z^{40} (S_v)^2) / (295147905179352825856 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (15635 \cdot R.^{43} \cdot R \cdot Z S^3 Z^{41} (S_v)^2) / (1328165573307087716352 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (185335180013 \cdot R.^{44} S^3 Z^{42} (S_v)^2) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (3115 \cdot R.^{45} \cdot R \cdot Z^2 S^3 Z^{43} (S_v)^2) / (21250649172913403461632 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (2057042720599 \cdot R.^{46} S^3 Z^{44} (S_v)^2) / (1360041547066457821544448 \cdot (1 + Z^{2/4} + Z^4/64)^4) \\
& + \dots \\
& (49 \cdot R.^{47} \cdot R \cdot Z S^3 Z^{45} (S_v)^2) / (56668397794435742564352 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (24026340573 \cdot R.^{48} S^3 Z^{46} (S_v)^2) / \dots \\
& (151115727451828646838272 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& (5273670271697 \cdot R.^{50} S^3 Z^{48} (S_v)^2) / (348170636049013202315378688 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (37823055319 \cdot R.^{52} S^3 Z^{50} (S_v)^2) / (29014219670751100192948224 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \\
& \dots \\
& (31266829573 \cdot R.^{54} S^3 Z^{52} (S_v)^2) / (309485009821345068724781056 \cdot (1 + Z^{2/4} + Z^4/64)^4) \\
& + \dots \\
& (305764487 \cdot R.^{56} S^3 Z^{54} (S_v)^2) / (43521329506126650289422336 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (155671821505 \cdot R.^{58} S^3 Z^{56} (S_v)^2) / (356526731314189519170947776512 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (8605263625 \cdot R.^{60} S^3 Z^{58} (S_v)^2) / (356526731314189519170947776512 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (4487015167 \cdot R.^{62} S^3 Z^{60} (S_v)^2) / (3802951800684688204490109616128 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (64197131 \cdot R.^{64} S^3 Z^{62} (S_v)^2) / (1267650600228229401496703205376 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (7366421503 \cdot R.^{66} S^3 Z^{64} (S_v)^2) / (3894222643901120721397872246915072 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (118374655 \cdot R.^{68} S^3 Z^{66} (S_v)^2) / (1947111321950560360698936123457536 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (103217975 \cdot R.^{70} S^3 Z^{68} (S_v)^2) / (62307562302417931542365955950641152 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (1169089 \cdot R.^{72} S^3 Z^{70} (S_v)^2) / (31153781151208965771182977975320576 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (16453715 \cdot R.^{74} S^3 Z^{72} (S_v)^2) / (23926103924128485712268527085046202368 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (234365 \cdot R.^{76} S^3 Z^{74} (S_v)^2) / (23926103924128485712268527085046202368 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (77905 \cdot R.^{78} S^3 Z^{76} (S_v)^2) / (765635325572111542792592866721478475776 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (175 \cdot R.^{80} S^3 Z^{78} (S_v)^2) / (255211775190703847597530955573826158592 \cdot (1 + Z^{2/4} + Z^4/64)^4) + \dots \\
& (49 \cdot R.^{82} S^3 Z^{80} (S_v)^2) / (21778071482940061661655974875633165533184 \cdot (1 + Z^{2/4} + Z^4/64)^4);
\end{aligned}$$

$Ns3=Nf3+Nc+Nr3$;
 $\Phi3=Nf3./[Nc+Nr3]$;
 $Be3=1./[1+\Phi3]$;
 $Gf3=Nf3./Ns3$;
 $Gr3=[Nr3]./Ns3$;
 $Nh3=Nc+Nr3$;

$S4=12$;
 $Nf4=Br*[(Z^2)*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)]$;
 $Nr4=(R.^2*S4^2)/4 + (25.*R.^2*S4^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)+$
 $(R.^2.*R.*Z^2*S4^2*(S_v))/(4*(1 + Z^2/4 + Z^4/64)^2) - ...$
 $(43.*R.^4*S4^2*Z^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2)...$
 $+ (5.*R.^5.*R.*Z*S4^2*Z^3*(S_v))/(32*(1 + Z^2/4 + Z^4/64)^2)+$
 $(407.*R.^6*S4^2*Z^4*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^7.*R.*Z*S4^2*Z^5*(S_v))/(768*(1 + Z^2/4 + Z^4/64)^2) +$
 $(539.*R.^8*S4^2*Z^6*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(85225.*R.^10*S4^2*Z^8*(S_v))/(1572864*(1 + Z^2/4 + Z^4/64)^2) +$
 $(6487.*R.^12*S4^2*Z^10*(S_v))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(17773.*R.^14*S4^2*Z^12*(S_v))/(4194304*(1 + Z^2/4 + Z^4/64)^2) +$
 $(2011.*R.^16*S4^2*Z^14*(S_v))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(206775.*R.^18*S4^2*Z^16*(S_v))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) +$
 $(108275.*R.^20*S4^2*Z^18*(S_v))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(512435.*R.^22*S4^2*Z^20*(S_v))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(21031.*R.^24*S4^2*Z^22*(S_v))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(272987.*R.^26*S4^2*Z^24*(S_v))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(11305.*R.^28*S4^2*Z^26*(S_v))/(219902325552*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(24225.*R.^30*S4^2*Z^28*(S_v))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) +$
 $(323.*R.^32*S4^2*Z^30*(S_v))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(27455.*R.^34*S4^2*Z^32*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +$
 $(855.*R.^36*S4^2*Z^34*(S_v))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(1805.*R.^38*S4^2*Z^36*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(25.*R.^40*S4^2*Z^38*(S_v))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^42*S4^2*Z^40*(S_v))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(625.*R.^2*S4^2*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(25.*R.^2.*R.*Z^2*S4^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) +$
 $(R.^2.*R.*Z^4*S4^2*(S_v)^2)/(16*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(1075.*R.^4*S4^2*Z^2*(S_v)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) +$
 $(43.*R.^4.*R.*Z^2*S4^2*Z^2*(S_v)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(125.*R.^5.*R.*Z*S4^2*Z^3*(S_v)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) +$
 $(5.*R.^5.*R.*Z^3*S4^2*Z^3*(S_v)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(60109.*R.^6*S4^2*Z^4*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(407.*R.^6.*R.*Z^2*S4^2*Z^4*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(4985.*R.^7.*R.*Z*S4^2*Z^5*(S_v)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) +$
 $(7.*R.^7.*R.*Z^3*S4^2*Z^5*(S_v)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(671.*R.^8*S4^2*Z^6*(S_v)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) +$
 $(739.*R.^8.*R.*Z^2*S4^2*Z^6*(S_v)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(17111.*R.^9.*R.*Z*S4^2*Z^7*(S_v)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) -$
 $(3787661.*R.^10*S4^2*Z^8*(S_v)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(31395.*R.^10.*R.*Z^2*S4^2*Z^8*(S_v)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) +$
 $(67529.*R.^11.*R.*Z*S4^2*Z^9*(S_v)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(1627151.*R.^12*S4^2*Z^10*(S_v)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(19657.*R.^12.*R.*Z^2*S4^2*Z^10*(S_v)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(486493.*R.^13.*R.*Z*S4^2*Z^11*(S_v)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) +$
 $(241027273.*R.^14*S4^2*Z^12*(S_v)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ...$

$$\begin{aligned}
& (17773.*R.^{14}.*R.*Z^2*S4^2*Z^{12}*(S_v)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^{15}.*R.*Z*S4^2*Z^{13}*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (53842355.*R.^{16}.*S4^2*Z^{14}*(S_v)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^{16}.*R.*Z^2*S4^2*Z^{14}*(S_v)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (981421.*R.^{17}.*R.*Z*S4^2*Z^{15}*(S_v)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^{18}.*S4^2*Z^{16}*(S_v)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (206775.*R.^{18}.*R.*Z^2*S4^2*Z^{16}*(S_v)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^{19}.*R.*Z*S4^2*Z^{17}*(S_v)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (944668661.*R.^{20}.*S4^2*Z^{18}*(S_v)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^{20}.*R.*Z^2*S4^2*Z^{18}*(S_v)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (4002553.*R.^{21}.*R.*Z*S4^2*Z^{19}*(S_v)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^{22}.*S4^2*Z^{20}*(S_v)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (512435.*R.^{22}.*R.*Z^2*S4^2*Z^{20}*(S_v)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^{23}.*R.*Z*S4^2*Z^{21}*(S_v)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (1484626111.*R.^{24}.*S4^2*Z^{22}*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^{24}.*R.*Z^2*S4^2*Z^{22}*(S_v)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (10718225.*R.^{25}.*R.*Z*S4^2*Z^{23}*(S_v)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^{26}.*S4^2*Z^{24}*(S_v)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (272987.*R.^{26}.*R.*Z^2*S4^2*Z^{24}*(S_v)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^{27}.*R.*Z*S4^2*Z^{25}*(S_v)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (24750045961.*R.^{28}.*S4^2*Z^{26}*(S_v)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^{28}.*R.*Z^2*S4^2*Z^{26}*(S_v)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (6450277.*R.^{29}.*R.*Z*S4^2*Z^{27}*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^{30}.*S4^2*Z^{28}*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (24225.*R.^{30}.*R.*Z^2*S4^2*Z^{28}*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^{31}.*R.*Z*S4^2*Z^{29}*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (36553306561.*R.^{32}.*S4^2*Z^{30}*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^{32}.*R.*Z^2*S4^2*Z^{30}*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (679915.*R.^{33}.*R.*Z*S4^2*Z^{31}*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^{34}.*S4^2*Z^{32}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^2*S4^2*Z^{32}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^{35}.*R.*Z*S4^2*Z^{33}*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (105030792781.*R.^{36}.*S4^2*Z^{34}*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^{36}.*R.*Z^2*S4^2*Z^{34}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (990641.*R.^{37}.*R.*Z*S4^2*Z^{35}*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^{38}.*S4^2*Z^{36}*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S4^2*Z^{36}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (294785.*R.^{39}.*R.*Z*S4^2*Z^{37}*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^{40}.*S4^2*Z^{38}*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S4^2*Z^{38}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (32965.*R.^{41}.*R.*Z*S4^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*S4^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S4^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (15635.*R.^{43}.*R.*Z*S4^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*S4^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S4^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (2057042720599.*R.^{46}.*S4^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) + \\
& + \dots \\
& (49.*R.^{47}.*R.*Z*S4^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*S4^2*Z^{46}*(S_v)^2)/...
\end{aligned}$$

$$\begin{aligned}
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^50*S4^2*Z^48*(S_v)^2)/(348170636049013202315378688*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (37823055319.*R.^52*S4^2*Z^50*(S_v)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (31266829573.*R.^54*S4^2*Z^52*(S_v)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (305764487.*R.^56*S4^2*Z^54*(S_v)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (155671821505.*R.^58*S4^2*Z^56*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (8605263625.*R.^60*S4^2*Z^58*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (4487015167.*R.^62*S4^2*Z^60*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (64197131.*R.^64*S4^2*Z^62*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (7366421503.*R.^66*S4^2*Z^64*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (118374655.*R.^68*S4^2*Z^66*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (103217975.*R.^70*S4^2*Z^68*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (1169089.*R.^72*S4^2*Z^70*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (16453715.*R.^74*S4^2*Z^72*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (234365.*R.^76*S4^2*Z^74*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (77905.*R.^78*S4^2*Z^76*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (175.*R.^80*S4^2*Z^78*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (49.*R.^82*S4^2*Z^80*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 + Z^4/64)^4);
\end{aligned}$$

$$\begin{aligned}
Ns4 &= Nf4 + Nc + Nr4; \\
Phi4 &= Nf4./[Nc + Nr4]; \\
Be4 &= 1./[1 + Phi4]; \\
Gf4 &= Nf4./Ns4; \\
Gr4 &= [Nr4]./Ns4; \\
Nh4 &= Nc + Nr4;
\end{aligned}$$

$$\begin{aligned}
S5 &= 16; \\
Nf5 &= Br*[(Z^2).exp(-2.*R.*Z) + (Z^2)*exp(-2*Z) - 2*Z^2.*exp(-Z-R.*Z)]; \\
Nr5 &= (R.^2*S5^2)/4 + (25.*R.^2*S5^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2) + \\
& (R.^2.*R.*Z^2*S5^2*(S_v))/(4*(1 + Z^2/4 + Z^4/64)^2) - \dots \\
& (43.*R.^4*S5^2*Z^2*(S_v))/(384*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& + (5.*R.^5.*R.*Z*S5^2*Z^3*(S_v))/(32*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (407.*R.^6*S5^2*Z^4*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (7.*R.^7.*R.*Z*S5^2*Z^5*(S_v))/(768*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (539.*R.^8*S5^2*Z^6*(S_v))/(4096*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (85225.*R.^10*S5^2*Z^8*(S_v))/(1572864*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (6487.*R.^12*S5^2*Z^10*(S_v))/(393216*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (17773.*R.^14*S5^2*Z^12*(S_v))/(4194304*(1 + Z^2/4 + Z^4/64)^2) + \dots \\
& (2011.*R.^16*S5^2*Z^14*(S_v))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + \dots
\end{aligned}$$

$$\begin{aligned}
& (206775.*R.^{18}*S^5*Z^{16}*(S_v))/(1073741824*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (108275.*R.^{20}*S^5*Z^{18}*(S_v))/(3221225472*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (512435.*R.^{22}*S^5*Z^{20}*(S_v))/(103079215104*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (21031.*R.^{24}*S^5*Z^{22}*(S_v))/(34359738368*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (272987.*R.^{26}*S^5*Z^{24}*(S_v))/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (11305.*R.^{28}*S^5*Z^{26}*(S_v))/(219902325552*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (24225.*R.^{30}*S^5*Z^{28}*(S_v))/(70368744177664*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (323.*R.^{32}*S^5*Z^{30}*(S_v))/(17592186044416*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (27455.*R.^{34}*S^5*Z^{32}*(S_v))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (855.*R.^{36}*S^5*Z^{34}*(S_v))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (1805.*R.^{38}*S^5*Z^{36}*(S_v))/(3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (25.*R.^{40}*S^5*Z^{38}*(S_v))/(3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (7.*R.^{42}*S^5*Z^{40}*(S_v))/(147573952589676412928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (625.*R.^2*S^5*Z^2*(S_v)^2)/(147456*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (25.*R.^2.*R.*Z^2*S^5*Z^2*(S_v)^2)/(768*(1 + Z^{2/4} + Z^{4/64})^4) + Z^{4/64})^4) + \\
& (R.^2.*R.*Z^4*S^5*Z^2*(S_v)^2)/(16*(1 + Z^{2/4} + Z^{4/64})^4) - \dots \\
& (1075.*R.^4*S^5*Z^2*(S_v)^2)/(73728*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (43.*R.^4.*R.*Z^2*S^5*Z^2*(S_v)^2)/(768*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (125.*R.^5.*R.*Z^5*S^5*Z^3*(S_v)^2)/(6144*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5.*R.^5.*R.*Z^3*S^5*Z^3*(S_v)^2)/(64*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (60109.*R.^6*S^5*Z^4*(S_v)^2)/(2359296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (407.*R.^6.*R.*Z^2*S^5*Z^4*(S_v)^2)/(8192*(1 + Z^{2/4} + Z^{4/64})^4) - \dots \\
& (4985.*R.^7.*R.*Z^5*S^5*Z^5*(S_v)^2)/(147456*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^7.*R.*Z^3*S^5*Z^5*(S_v)^2)/(1536*(1 + Z^{2/4} + Z^{4/64})^4) - \dots \\
& (671.*R.^8*S^5*Z^6*(S_v)^2)/(131072*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (739.*R.^8.*R.*Z^2*S^5*Z^6*(S_v)^2)/(8192*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (17111.*R.^9.*R.*Z^5*S^5*Z^7*(S_v)^2)/(589824*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (3787661.*R.^10*S^5*Z^8*(S_v)^2)/(301989888*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (31395.*R.^10.*R.*Z^2*S^5*Z^8*(S_v)^2)/(1048576*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (67529.*R.^11.*R.*Z^7*S^5*Z^9*(S_v)^2)/(1572864*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (1627151.*R.^12*S^5*Z^{10}*(S_v)^2)/(100663296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19657.*R.^12.*R.*Z^2*S^5*Z^{10}*(S_v)^2)/(2359296*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (486493.*R.^13.*R.*Z^5*S^5*Z^{11}*(S_v)^2)/(25165824*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (241027273.*R.^14*S^5*Z^{12}*(S_v)^2)/(9663676416*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (17773.*R.^14.*R.*Z^2*S^5*Z^{12}*(S_v)^2)/(8388608*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3710335.*R.^15.*R.*Z^5*S^5*Z^{13}*(S_v)^2)/(603979776*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (53842355.*R.^16*S^5*Z^{14}*(S_v)^2)/(3221225472*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (2011.*R.^16.*R.*Z^2*S^5*Z^{14}*(S_v)^2)/(4194304*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (981421.*R.^17.*R.*Z^5*S^5*Z^{15}*(S_v)^2)/(603979776*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19618549477.*R.^18*S^5*Z^{16}*(S_v)^2)/(2473901162496*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (206775.*R.^18.*R.*Z^2*S^5*Z^{16}*(S_v)^2)/(2147483648*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (607051.*R.^19.*R.*Z^7*S^5*Z^{17}*(S_v)^2)/(1610612736*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (944668661.*R.^20*S^5*Z^{18}*(S_v)^2)/(309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^20.*R.*Z^2*S^5*Z^{18}*(S_v)^2)/(6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (4002553.*R.^21.*R.*Z^5*S^5*Z^{19}*(S_v)^2)/(51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^22*S^5*Z^{20}*(S_v)^2)/(3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (512435.*R.^22.*R.*Z^2*S^5*Z^{20}*(S_v)^2)/(206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^23.*R.*Z^5*S^5*Z^{21}*(S_v)^2)/(412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (1484626111.*R.^24*S^5*Z^{22}*(S_v)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^24.*R.*Z^2*S^5*Z^{22}*(S_v)^2)/(68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (10718225.*R.^25.*R.*Z^5*S^5*Z^{23}*(S_v)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^26*S^5*Z^{24}*(S_v)^2)/(422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (272987.*R.^26.*R.*Z^2*S^5*Z^{24}*(S_v)^2)/(8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^27.*R.*Z^5*S^5*Z^{25}*(S_v)^2)/(39582418599936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (24750045961.*R.^28*S^5*Z^{26}*(S_v)^2)/(1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^28.*R.*Z^2*S^5*Z^{26}*(S_v)^2)/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + \dots
\end{aligned}$$

$$\begin{aligned}
& (6450277.*R.^{29}.*R.*Z*S5^2*Z^{27}*(S_v)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^{30}*S5^2*Z^{28}*(S_v)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^{30}.*R.*Z^2*S5^2*Z^{28}*(S_v)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^{31}.*R.*Z*S5^2*Z^{29}*(S_v)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^{32}*S5^2*Z^{30}*(S_v)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^{32}.*R.*Z^2*S5^2*Z^{30}*(S_v)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^{33}.*R.*Z*S5^2*Z^{31}*(S_v)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^{34}*S5^2*Z^{32}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^{34}.*R.*Z^2*S5^2*Z^{32}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^{35}.*R.*Z*S5^2*Z^{33}*(S_v)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^{36}*S5^2*Z^{34}*(S_v)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^{36}.*R.*Z^2*S5^2*Z^{34}*(S_v)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^{37}.*R.*Z*S5^2*Z^{35}*(S_v)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^{38}*S5^2*Z^{36}*(S_v)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S5^2*Z^{36}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^{39}.*R.*Z*S5^2*Z^{37}*(S_v)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^{40}*S5^2*Z^{38}*(S_v)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S5^2*Z^{38}*(S_v)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (32965.*R.^{41}.*R.*Z*S5^2*Z^{39}*(S_v)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}*S5^2*Z^{40}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S5^2*Z^{40}*(S_v)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (15635.*R.^{43}.*R.*Z*S5^2*Z^{41}*(S_v)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}*S5^2*Z^{42}*(S_v)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S5^2*Z^{43}*(S_v)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2057042720599.*R.^{46}*S5^2*Z^{44}*(S_v)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (49.*R.^{47}.*R.*Z*S5^2*Z^{45}*(S_v)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}*S5^2*Z^{46}*(S_v)^2)/... \\
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^{50}*S5^2*Z^{48}*(S_v)^2)/(348170636049013202315378688*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (37823055319.*R.^{52}*S5^2*Z^{50}*(S_v)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (31266829573.*R.^{54}*S5^2*Z^{52}*(S_v)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (305764487.*R.^{56}*S5^2*Z^{54}*(S_v)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (155671821505.*R.^{58}*S5^2*Z^{56}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (8605263625.*R.^{60}*S5^2*Z^{58}*(S_v)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4487015167.*R.^{62}*S5^2*Z^{60}*(S_v)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (64197131.*R.^{64}*S5^2*Z^{62}*(S_v)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (7366421503.*R.^{66}*S5^2*Z^{64}*(S_v)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (118374655.*R.^{68}*S5^2*Z^{66}*(S_v)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (103217975.*R.^{70}*S5^2*Z^{68}*(S_v)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1169089.*R.^{72}*S5^2*Z^{70}*(S_v)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + Z^4/64)^4) + ...
\end{aligned}$$

```

(16453715.*R.^74*S5^2*Z^72*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 +
Z^4/64)^4) + ...
(234365.*R.^76*S5^2*Z^74*(S_v)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 +
Z^4/64)^4) + ...
(77905.*R.^78*S5^2*Z^76*(S_v)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 +
Z^4/64)^4) + ...
(175.*R.^80*S5^2*Z^78*(S_v)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 +
Z^4/64)^4) + ...
(49.*R.^82*S5^2*Z^80*(S_v)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 +
Z^4/64)^4);

```

```

Ns5=Nf5+Nc+Nr5;
Phi5=Nf5./[Nc+Nr5];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gr5=[Nr5]./Ns5;
Nh5=Nc+Nr5;

```

```

plot(R,Ns1,'b',R,Ns2,'g',R,Ns3,'r',R,Ns4,'k',R,Ns5,'m')

% plot(R,Be1,'b',R,Be2,'g',R,Be3,'r',R,Be4,'k',R,Be5,'m')

% plot(R,Phi1,'b',R,Phi2,'g',R,Phi3,'r',R,Phi4,'k',R,Phi5,'m')

% plot(R,Gf1,'b',R,Gf2,'g',R,Gf3,'r',R,Gf4,'k',R,Gf5,'m')

% plot(R,Gr1,'b',R,Gr2,'g',R,Gr3,'r',R,Gr4,'k',R,Gr5,'m')

% plot(R,Nf1,'b',R,Nf2,'g',R,Nf3,'r',R,Nf4,'k',R,Nf5,'m')

% plot(R,Nh1,'b',R,Nh2,'g',R,Nh3,'r',R,Nh4,'k',R,Nh5,'m')

```

PLOTTOOLS ON

2.5. Distribution of $N_s, Be, \Phi, G_F, G_R, N_F$ and N_H versus Y for a range of S_v

and set of S, Z, Br & Pe

S=1; Z=1; Br=1; Pe=10;
% S=2.5; Z=2; Br=0.5; Pe=5;

% % % % Z=4; S=10; Br=0.6; Pe=8;
% % % % Z=5; S=0.75; Br=0.2; Pe=2;
% % % % Z=10; S=5; Br=1; Pe=7.5;
% % % % Z=20; S=15; Br=0.9; Pe=10;

q=1.86;
s=1;
Dh=250*10⁻⁶;
R=0:0.005:1;

Nc=[1/Pe^2]*[16*q^2+s^2*Dh^2+8*q*s*Dh];

S_v1=1;
Nf1=Br*[(Z^2).*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)];
Nr1=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v1))/(384*(1 + Z^2/4 + Z^4/64)^2)+
(R.^2.*R.*Z^2*S^2*(S_v1))/(4*(1 + Z^2/4 + Z^4/64)^2) - ...
(43.*R.^4*S^2*Z^2*(S_v1))/(384*(1 + Z^2/4 + Z^4/64)^2)...
+ (5.*R.^5.*R.*Z*S^2*Z^3*(S_v1))/(32*(1 + Z^2/4 + Z^4/64)^2)+
(407.*R.^6*S^2*Z^4*(S_v1))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...
(7.*R.^7.*R.*Z*S^2*Z^5*(S_v1))/(768*(1 + Z^2/4 + Z^4/64)^2) +
(539.*R.^8*S^2*Z^6*(S_v1))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...
(85225.*R.^10*S^2*Z^8*(S_v1))/(1572864*(1 + Z^2/4 + Z^4/64)^2) +
(6487.*R.^12*S^2*Z^10*(S_v1))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ...
(17773.*R.^14*S^2*Z^12*(S_v1))/(4194304*(1 + Z^2/4 + Z^4/64)^2) +
(2011.*R.^16*S^2*Z^14*(S_v1))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...
(206775.*R.^18*S^2*Z^16*(S_v1))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) +
(108275.*R.^20*S^2*Z^18*(S_v1))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) + ...
(512435.*R.^22*S^2*Z^20*(S_v1))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) +
(21031.*R.^24*S^2*Z^22*(S_v1))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) + ...
(272987.*R.^26*S^2*Z^24*(S_v1))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) +
(11305.*R.^28*S^2*Z^26*(S_v1))/(2199023255552*(1 + Z^2/4 + Z^4/64)^2) + ...
(24225.*R.^30*S^2*Z^28*(S_v1))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) +
(323.*R.^32*S^2*Z^30*(S_v1))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...
(27455.*R.^34*S^2*Z^32*(S_v1))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +
(855.*R.^36*S^2*Z^34*(S_v1))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...
(1805.*R.^38*S^2*Z^36*(S_v1))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +
(25.*R.^40*S^2*Z^38*(S_v1))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...
(7.*R.^42*S^2*Z^40*(S_v1))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +
(625.*R.^2*S^2*(S_v1)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ...
(25.*R.^2.*R.*Z^2*S^2*(S_v1)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) +
(R.^2.*R.*Z^4*S^2*(S_v1)^2)/(16*(1 + Z^2/4 + Z^4/64)^4) - ...
(1075.*R.^4*S^2*Z^2*(S_v1)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) -
(43.*R.^4.*R.*Z^2*S^2*Z^2*(S_v1)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ...

$$\begin{aligned}
& (125.*R.^5.*R.*Z*S^2*Z^3*(S_v1)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5.*R.^5.*R.*Z^3*S^2*Z^3*(S_v1)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (60109.*R.^6.*R.*Z^4*S^2*Z^4*(S_v1)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (407.*R.^6.*R.*Z^2*S^2*Z^4*(S_v1)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (4985.*R.^7.*R.*Z*S^2*Z^5*(S_v1)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^7.*R.*Z^3*S^2*Z^5*(S_v1)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ... \\
& (671.*R.^8.*R.*Z^2*S^2*Z^6*(S_v1)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) + \\
& (739.*R.^8.*R.*Z^2*S^2*Z^6*(S_v1)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17111.*R.^9.*R.*Z*S^2*Z^7*(S_v1)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) - \\
& (3787661.*R.^10.*R.*Z^8*S^2*Z^8*(S_v1)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_v1)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) + \\
& (67529.*R.^11.*R.*Z*S^2*Z^9*(S_v1)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1627151.*R.^12.*R.*Z^2*S^2*Z^10*(S_v1)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19657.*R.^12.*R.*Z^2*S^2*Z^10*(S_v1)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (486493.*R.^13.*R.*Z*S^2*Z^11*(S_v1)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) + \\
& (241027273.*R.^14.*R.*Z^2*S^2*Z^12*(S_v1)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S^2*Z^12*(S_v1)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^15.*R.*Z*S^2*Z^13*(S_v1)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (53842355.*R.^16.*R.*Z^2*S^2*Z^14*(S_v1)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^16.*R.*Z^2*S^2*Z^14*(S_v1)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (981421.*R.^17.*R.*Z*S^2*Z^15*(S_v1)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^18.*R.*Z^2*S^2*Z^16*(S_v1)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S^2*Z^16*(S_v1)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^19.*R.*Z*S^2*Z^17*(S_v1)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (944668661.*R.^20.*R.*Z^2*S^2*Z^18*(S_v1)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^20.*R.*Z^2*S^2*Z^18*(S_v1)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (4002553.*R.^21.*R.*Z*S^2*Z^19*(S_v1)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^22.*R.*Z^2*S^2*Z^20*(S_v1)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S^2*Z^20*(S_v1)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^23.*R.*Z*S^2*Z^21*(S_v1)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (1484626111.*R.^24.*R.*Z^2*S^2*Z^22*(S_v1)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^24.*R.*Z^2*S^2*Z^22*(S_v1)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (10718225.*R.^25.*R.*Z*S^2*Z^23*(S_v1)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^26.*R.*Z^2*S^2*Z^24*(S_v1)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S^2*Z^24*(S_v1)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^27.*R.*Z*S^2*Z^25*(S_v1)^2)/(3958241859936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24750045961.*R.^28.*R.*Z^2*S^2*Z^26*(S_v1)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^28.*R.*Z^2*S^2*Z^26*(S_v1)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (6450277.*R.^29.*R.*Z*S^2*Z^27*(S_v1)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^30.*R.*Z^2*S^2*Z^28*(S_v1)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S^2*Z^28*(S_v1)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^31.*R.*Z*S^2*Z^29*(S_v1)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (36553306561.*R.^32.*R.*Z^2*S^2*Z^30*(S_v1)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^32.*R.*Z^2*S^2*Z^30*(S_v1)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (679915.*R.^33.*R.*Z*S^2*Z^31*(S_v1)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^34.*R.*Z^2*S^2*Z^32*(S_v1)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S^2*Z^32*(S_v1)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^35.*R.*Z*S^2*Z^33*(S_v1)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (105030792781.*R.^36.*R.*Z^2*S^2*Z^34*(S_v1)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^36.*R.*Z^2*S^2*Z^34*(S_v1)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (990641.*R.^37.*R.*Z*S^2*Z^35*(S_v1)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^38.*R.*Z^2*S^2*Z^36*(S_v1)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^38.*R.*Z^2*S^2*Z^36*(S_v1)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (294785.*R.^39.*R.*Z*S^2*Z^37*(S_v1)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^40.*R.*Z^2*S^2*Z^38*(S_v1)^2)/...
\end{aligned}$$

$$\begin{aligned}
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^38*(S_v1)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (32965.*R.^{41}.*R.*Z*S^2*Z^39*(S_v1)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*S^2*Z^40*(S_v1)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^40*(S_v1)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^41*(S_v1)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*S^2*Z^42*(S_v1)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^43*(S_v1)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (2057042720599.*R.^{46}.*S^2*Z^44*(S_v1)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (49.*R.^{47}.*R.*Z*S^2*Z^45*(S_v1)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*S^2*Z^46*(S_v1)^2)/... \\
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^{50}.*S^2*Z^48*(S_v1)^2)/(348170636049013202315378688*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (37823055319.*R.^{52}.*S^2*Z^50*(S_v1)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \\
& ... \\
& (31266829573.*R.^{54}.*S^2*Z^52*(S_v1)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) \\
& + ... \\
& (305764487.*R.^{56}.*S^2*Z^54*(S_v1)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + ... \\
& (155671821505.*R.^{58}.*S^2*Z^56*(S_v1)^2)/(356526731314189519170947776512*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (8605263625.*R.^{60}.*S^2*Z^58*(S_v1)^2)/(356526731314189519170947776512*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (4487015167.*R.^{62}.*S^2*Z^60*(S_v1)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (64197131.*R.^{64}.*S^2*Z^62*(S_v1)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (7366421503.*R.^{66}.*S^2*Z^64*(S_v1)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (118374655.*R.^{68}.*S^2*Z^66*(S_v1)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (103217975.*R.^{70}.*S^2*Z^68*(S_v1)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (1169089.*R.^{72}.*S^2*Z^70*(S_v1)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (16453715.*R.^{74}.*S^2*Z^72*(S_v1)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (234365.*R.^{76}.*S^2*Z^74*(S_v1)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (77905.*R.^{78}.*S^2*Z^76*(S_v1)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (175.*R.^{80}.*S^2*Z^78*(S_v1)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 + \\
& Z^4/64)^4) + ... \\
& (49.*R.^{82}.*S^2*Z^80*(S_v1)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 + \\
& Z^4/64)^4);
\end{aligned}$$

$$\begin{aligned}
Ns1 &= Nf1 + Nc + Nr1; \\
Phi1 &= Nf1./[Nc + Nr1]; \\
Be1 &= 1./[1 + Phi1]; \\
Gf1 &= Nf1./Ns1; \\
Gr1 &= [Nr1]./Ns1; \\
Nh1 &= Nc + Nr1;
\end{aligned}$$

$S_{v2}=4;$
 $Nf2=Br[(Z^2).exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)];$
 $Nr2=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_{v2}))/((384*(1 + Z^2/4 + Z^4/64)^2)+$
 $(R.^2.*R.*Z^2*S^2*(S_{v2}))/((4*(1 + Z^2/4 + Z^4/64)^2) - ...$
 $(43.*R.^4*S^2*Z^2*(S_{v2}))/((384*(1 + Z^2/4 + Z^4/64)^2)...$
 $+ (5.*R.^5.*R.*Z*S^2*Z^3*(S_{v2}))/((32*(1 + Z^2/4 + Z^4/64)^2)+$
 $(407.*R.^6*S^2*Z^4*(S_{v2}))/((4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^7.*R.*Z*S^2*Z^5*(S_{v2}))/((768*(1 + Z^2/4 + Z^4/64)^2) +$
 $(539.*R.^8*S^2*Z^6*(S_{v2}))/((4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(85225.*R.^10*S^2*Z^8*(S_{v2}))/((1572864*(1 + Z^2/4 + Z^4/64)^2) +$
 $(6487.*R.^12*S^2*Z^10*(S_{v2}))/((393216*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(17773.*R.^14*S^2*Z^12*(S_{v2}))/((4194304*(1 + Z^2/4 + Z^4/64)^2) +$
 $(2011.*R.^16*S^2*Z^14*(S_{v2}))/((2097152*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(206775.*R.^18*S^2*Z^16*(S_{v2}))/((1073741824*(1 + Z^2/4 + Z^4/64)^2) +$
 $(108275.*R.^20*S^2*Z^18*(S_{v2}))/((3221225472*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(512435.*R.^22*S^2*Z^20*(S_{v2}))/((103079215104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(21031.*R.^24*S^2*Z^22*(S_{v2}))/((34359738368*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(272987.*R.^26*S^2*Z^24*(S_{v2}))/((4398046511104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(11305.*R.^28*S^2*Z^26*(S_{v2}))/((2199023255552*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(24225.*R.^30*S^2*Z^28*(S_{v2}))/((70368744177664*(1 + Z^2/4 + Z^4/64)^2) +$
 $(323.*R.^32*S^2*Z^30*(S_{v2}))/((17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(27455.*R.^34*S^2*Z^32*(S_{v2}))/((36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +$
 $(855.*R.^36*S^2*Z^34*(S_{v2}))/((36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(1805.*R.^38*S^2*Z^36*(S_{v2}))/((3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(25.*R.^40*S^2*Z^38*(S_{v2}))/((3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^42*S^2*Z^40*(S_{v2}))/((147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(625.*R.^2*S^2*(S_{v2})^2)/((147456*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(25.*R.^2.*R.*Z^2*S^2*(S_{v2})^2)/((768*(1 + Z^2/4 + Z^4/64)^4) +$
 $(R.^2.*R.*Z^4*S^2*(S_{v2})^2)/((16*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(1075.*R.^4*S^2*Z^2*(S_{v2})^2)/((73728*(1 + Z^2/4 + Z^4/64)^4) -$
 $(43.*R.^4.*R.*Z^2*S^2*Z^2*(S_{v2})^2)/((768*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(125.*R.^5.*R.*Z*S^2*Z^3*(S_{v2})^2)/((6144*(1 + Z^2/4 + Z^4/64)^4) +$
 $(5.*R.^5.*R.*Z^3*S^2*Z^3*(S_{v2})^2)/((64*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(60109.*R.^6*S^2*Z^4*(S_{v2})^2)/((2359296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(407.*R.^6.*R.*Z^2*S^2*Z^4*(S_{v2})^2)/((8192*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(4985.*R.^7.*R.*Z*S^2*Z^5*(S_{v2})^2)/((147456*(1 + Z^2/4 + Z^4/64)^4) +$
 $(7.*R.^7.*R.*Z^3*S^2*Z^5*(S_{v2})^2)/((1536*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(671.*R.^8*S^2*Z^6*(S_{v2})^2)/((131072*(1 + Z^2/4 + Z^4/64)^4) +$
 $(739.*R.^8.*R.*Z^2*S^2*Z^6*(S_{v2})^2)/((8192*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(17111.*R.^9.*R.*Z*S^2*Z^7*(S_{v2})^2)/((589824*(1 + Z^2/4 + Z^4/64)^4) -$
 $(3787661.*R.^10*S^2*Z^8*(S_{v2})^2)/((301989888*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_{v2})^2)/((1048576*(1 + Z^2/4 + Z^4/64)^4) +$
 $(67529.*R.^11.*R.*Z*S^2*Z^9*(S_{v2})^2)/((1572864*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(1627151.*R.^12*S^2*Z^10*(S_{v2})^2)/((100663296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(19657.*R.^12.*R.*Z^2*S^2*Z^10*(S_{v2})^2)/((2359296*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(486493.*R.^13.*R.*Z*S^2*Z^11*(S_{v2})^2)/((25165824*(1 + Z^2/4 + Z^4/64)^4) +$
 $(241027273.*R.^14*S^2*Z^12*(S_{v2})^2)/((9663676416*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(17773.*R.^14.*R.*Z^2*S^2*Z^12*(S_{v2})^2)/((8388608*(1 + Z^2/4 + Z^4/64)^4) +$
 $(3710335.*R.^15.*R.*Z*S^2*Z^13*(S_{v2})^2)/((603979776*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(53842355.*R.^16*S^2*Z^14*(S_{v2})^2)/((3221225472*(1 + Z^2/4 + Z^4/64)^4) +$
 $(2011.*R.^16.*R.*Z^2*S^2*Z^14*(S_{v2})^2)/((4194304*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(981421.*R.^17.*R.*Z*S^2*Z^15*(S_{v2})^2)/((603979776*(1 + Z^2/4 + Z^4/64)^4) +$
 $(19618549477.*R.^18*S^2*Z^16*(S_{v2})^2)/((2473901162496*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(206775.*R.^18.*R.*Z^2*S^2*Z^16*(S_{v2})^2)/((2147483648*(1 + Z^2/4 + Z^4/64)^4) +$
 $(607051.*R.^19.*R.*Z*S^2*Z^17*(S_{v2})^2)/((1610612736*(1 + Z^2/4 + Z^4/64)^4) + ...$

$$\begin{aligned}
& (944668661.*R.^{20}*S^2*Z^{18}*(S_v2)^2)/(309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^{20}.*R.*Z^2*S^2*Z^{18}*(S_v2)^2)/(6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (4002553.*R.^{21}.*R.*Z*S^2*Z^{19}*(S_v2)^2)/(51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^{22}*S^2*Z^{20}*(S_v2)^2)/(3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (512435.*R.^{22}.*R.*Z^2*S^2*Z^{20}*(S_v2)^2)/(206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^{23}.*R.*Z*S^2*Z^{21}*(S_v2)^2)/(412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1484626111.*R.^{24}*S^2*Z^{22}*(S_v2)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^{24}.*R.*Z^2*S^2*Z^{22}*(S_v2)^2)/(68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (10718225.*R.^{25}.*R.*Z*S^2*Z^{23}*(S_v2)^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^{26}*S^2*Z^{24}*(S_v2)^2)/(422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (272987.*R.^{26}.*R.*Z^2*S^2*Z^{24}*(S_v2)^2)/(8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^{27}.*R.*Z*S^2*Z^{25}*(S_v2)^2)/(39582418599936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24750045961.*R.^{28}*S^2*Z^{26}*(S_v2)^2)/(1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^{28}.*R.*Z^2*S^2*Z^{26}*(S_v2)^2)/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (6450277.*R.^{29}.*R.*Z*S^2*Z^{27}*(S_v2)^2)/(211106232532992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (59064594011.*R.^{30}*S^2*Z^{28}*(S_v2)^2)/(13510798882111488*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24225.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v2)^2)/(140737488355328*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (4624109.*R.^{31}.*R.*Z*S^2*Z^{29}*(S_v2)^2)/(1688849860263936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (36553306561.*R.^{32}*S^2*Z^{30}*(S_v2)^2)/(40532396646334464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (323.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v2)^2)/(35184372088832*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (679915.*R.^{33}.*R.*Z*S^2*Z^{31}*(S_v2)^2)/(3377699720527872*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1189947216611.*R.^{34}*S^2*Z^{32}*(S_v2)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (27455.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v2)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108205.*R.^{35}.*R.*Z*S^2*Z^{33}*(S_v2)^2)/(9007199254740992*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (105030792781.*R.^{36}*S^2*Z^{34}*(S_v2)^2)/(3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (855.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v2)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (990641.*R.^{37}.*R.*Z*S^2*Z^{35}*(S_v2)^2)/(1729382256910270464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (548568674633.*R.^{38}*S^2*Z^{36}*(S_v2)^2)/... \\
& (110680464442257309696*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v2)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (294785.*R.^{39}.*R.*Z*S^2*Z^{37}*(S_v2)^2)/(13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (10322387501.*R.^{40}*S^2*Z^{38}*(S_v2)^2)/... \\
& (13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v2)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (32965.*R.^{41}.*R.*Z*S^2*Z^{39}*(S_v2)^2)/(55340232221128654848*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1462601471251.*R.^{42}*S^2*Z^{40}*(S_v2)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v2)^2)/(295147905179352825856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v2)^2)/(1328165573307087716352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (185335180013.*R.^{44}*S^2*Z^{42}*(S_v2)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3115.*R.^{45}.*R.*Z^2*S^2*Z^{43}*(S_v2)^2)/(21250649172913403461632*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (2057042720599.*R.^{46}*S^2*Z^{44}*(S_v2)^2)/(1360041547066457821544448*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + ... \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v2)^2)/(56668397794435742564352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (24026340573.*R.^{48}*S^2*Z^{46}*(S_v2)^2)/... \\
& (151115727451828646838272*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5273670271697.*R.^{50}*S^2*Z^{48}*(S_v2)^2)/(348170636049013202315378688*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (37823055319.*R.^{52}*S^2*Z^{50}*(S_v2)^2)/(29014219670751100192948224*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& ... \\
& (31266829573.*R.^{54}*S^2*Z^{52}*(S_v2)^2)/(309485009821345068724781056*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + ... \\
& (305764487.*R.^{56}*S^2*Z^{54}*(S_v2)^2)/(43521329506126650289422336*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (155671821505.*R.^{58}*S^2*Z^{56}*(S_v2)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (8605263625.*R.^{60}*S^2*Z^{58}*(S_v2)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (4487015167.*R.^{62}*S^2*Z^{60}*(S_v2)^2)/(3802951800684688204490109616128*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (64197131.*R.^{64}*S^2*Z^{62}*(S_v2)^2)/(1267650600228229401496703205376*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (7366421503.*R.^{66}*S^2*Z^{64}*(S_v2)^2)/(3894222643901120721397872246915072*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (118374655.*R.^{68}*S^2*Z^{66}*(S_v2)^2)/(1947111321950560360698936123457536*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (103217975.*R.^{70}*S^2*Z^{68}*(S_v2)^2)/(62307562302417931542365955950641152*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (1169089.*R.^{72}*S^2*Z^{70}*(S_v2)^2)/(31153781151208965771182977975320576*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (16453715.*R.^{74}*S^2*Z^{72}*(S_v2)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (234365.*R.^{76}*S^2*Z^{74}*(S_v2)^2)/(23926103924128485712268527085046202368*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (77905.*R.^{78}*S^2*Z^{76}*(S_v2)^2)/(765635325572111542792592866721478475776*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (175.*R.^{80}*S^2*Z^{78}*(S_v2)^2)/(255211775190703847597530955573826158592*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (49.*R.^{82}*S^2*Z^{80}*(S_v2)^2)/(21778071482940061661655974875633165533184*(1 + Z^{2/4} + Z^{4/64})^4);
\end{aligned}$$

$$\begin{aligned}
Ns2 &= Nf2 + Nc + Nr2; \\
Phi2 &= Nf2./[Nc + Nr2]; \\
Be2 &= 1./[1 + Phi2]; \\
Gf2 &= Nf2./Ns2; \\
Gr2 &= [Nr2]./Ns2; \\
Nh2 &= Nc + Nr2;
\end{aligned}$$

$$\begin{aligned}
S_v3 &= 8; \\
Nf3 &= Br*[(Z^2).*exp(-2.*R.*Z) + (Z^2)*exp(-2*Z) - 2*Z^2.*exp(-Z-R.*Z)]; \\
Nr3 &= (R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v3))/(384*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (R.^2.*R.*Z^2*S^2*(S_v3))/(4*(1 + Z^{2/4} + Z^{4/64})^2) - \dots \\
& (43.*R.^4*S^2*Z^2*(S_v3))/(384*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& + (5.*R.^5.*R.*Z*S^2*Z^3*(S_v3))/(32*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (407.*R.^6*S^2*Z^4*(S_v3))/(4096*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (7.*R.^7.*R.*Z*S^2*Z^5*(S_v3))/(768*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (539.*R.^8*S^2*Z^6*(S_v3))/(4096*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (85225.*R.^10*S^2*Z^8*(S_v3))/(1572864*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (6487.*R.^12*S^2*Z^10*(S_v3))/(393216*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (17773.*R.^14*S^2*Z^12*(S_v3))/(4194304*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (2011.*R.^16*S^2*Z^14*(S_v3))/(2097152*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (206775.*R.^18*S^2*Z^16*(S_v3))/(1073741824*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (108275.*R.^20*S^2*Z^18*(S_v3))/(3221225472*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (512435.*R.^22*S^2*Z^20*(S_v3))/(103079215104*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (21031.*R.^24*S^2*Z^22*(S_v3))/(34359738368*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (272987.*R.^26*S^2*Z^24*(S_v3))/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (11305.*R.^28*S^2*Z^26*(S_v3))/(2199023255552*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (24225.*R.^30*S^2*Z^28*(S_v3))/(70368744177664*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (323.*R.^32*S^2*Z^30*(S_v3))/(17592186044416*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (27455.*R.^34*S^2*Z^32*(S_v3))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \dots \\
& (855.*R.^36*S^2*Z^34*(S_v3))/(36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \dots
\end{aligned}$$

$$\begin{aligned}
& (1805.*R.^{38}*S^2*Z^{36}*(S_{v3}))/ (3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (25.*R.^{40}*S^2*Z^{38}*(S_{v3}))/ (3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (7.*R.^{42}*S^2*Z^{40}*(S_{v3}))/ (147573952589676412928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (625.*R.^2*S^2*(S_{v3})^2)/ (147456*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (25.*R.^2.*R.*Z^2*S^2*(S_{v3})^2)/ (768*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (R.^2.*R.*Z^4*S^2*(S_{v3})^2)/ (16*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (1075.*R.^4*S^2*Z^2*(S_{v3})^2)/ (73728*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (43.*R.^4.*R.*Z^2*S^2*Z^2*(S_{v3})^2)/ (768*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (125.*R.^5.*R.*Z*S^2*Z^3*(S_{v3})^2)/ (6144*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5.*R.^5.*R.*Z^3*S^2*Z^3*(S_{v3})^2)/ (64*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (60109.*R.^6*S^2*Z^4*(S_{v3})^2)/ (2359296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (407.*R.^6.*R.*Z^2*S^2*Z^4*(S_{v3})^2)/ (8192*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (4985.*R.^7.*R.*Z*S^2*Z^5*(S_{v3})^2)/ (147456*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^7.*R.*Z^3*S^2*Z^5*(S_{v3})^2)/ (1536*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (671.*R.^8*S^2*Z^6*(S_{v3})^2)/ (131072*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (739.*R.^8.*R.*Z^2*S^2*Z^6*(S_{v3})^2)/ (8192*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17111.*R.^9.*R.*Z*S^2*Z^7*(S_{v3})^2)/ (589824*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (3787661.*R.^10*S^2*Z^8*(S_{v3})^2)/ (301989888*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_{v3})^2)/ (1048576*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (67529.*R.^11.*R.*Z*S^2*Z^9*(S_{v3})^2)/ (1572864*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1627151.*R.^12*S^2*Z^{10}*(S_{v3})^2)/ (100663296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19657.*R.^12.*R.*Z^2*S^2*Z^{10}*(S_{v3})^2)/ (2359296*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (486493.*R.^13.*R.*Z*S^2*Z^{11}*(S_{v3})^2)/ (25165824*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (241027273.*R.^14*S^2*Z^{12}*(S_{v3})^2)/ (9663676416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17773.*R.^14.*R.*Z^2*S^2*Z^{12}*(S_{v3})^2)/ (8388608*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3710335.*R.^15.*R.*Z*S^2*Z^{13}*(S_{v3})^2)/ (603979776*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (53842355.*R.^16*S^2*Z^{14}*(S_{v3})^2)/ (3221225472*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (2011.*R.^16.*R.*Z^2*S^2*Z^{14}*(S_{v3})^2)/ (4194304*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (981421.*R.^17.*R.*Z*S^2*Z^{15}*(S_{v3})^2)/ (603979776*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19618549477.*R.^18*S^2*Z^{16}*(S_{v3})^2)/ (2473901162496*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (206775.*R.^18.*R.*Z^2*S^2*Z^{16}*(S_{v3})^2)/ (2147483648*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (607051.*R.^19.*R.*Z*S^2*Z^{17}*(S_{v3})^2)/ (1610612736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (944668661.*R.^20*S^2*Z^{18}*(S_{v3})^2)/ (309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^20.*R.*Z^2*S^2*Z^{18}*(S_{v3})^2)/ (6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (4002553.*R.^21.*R.*Z*S^2*Z^{19}*(S_{v3})^2)/ (51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^22*S^2*Z^{20}*(S_{v3})^2)/ (3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (512435.*R.^22.*R.*Z^2*S^2*Z^{20}*(S_{v3})^2)/ (206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^23.*R.*Z*S^2*Z^{21}*(S_{v3})^2)/ (412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1484626111.*R.^24*S^2*Z^{22}*(S_{v3})^2)/ (4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^24.*R.*Z^2*S^2*Z^{22}*(S_{v3})^2)/ (68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (10718225.*R.^25.*R.*Z*S^2*Z^{23}*(S_{v3})^2)/ (4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^26*S^2*Z^{24}*(S_{v3})^2)/ (422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (272987.*R.^26.*R.*Z^2*S^2*Z^{24}*(S_{v3})^2)/ (8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^27.*R.*Z*S^2*Z^{25}*(S_{v3})^2)/ (39582418599936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24750045961.*R.^28*S^2*Z^{26}*(S_{v3})^2)/ (1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^28.*R.*Z^2*S^2*Z^{26}*(S_{v3})^2)/ (4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (6450277.*R.^29.*R.*Z*S^2*Z^{27}*(S_{v3})^2)/ (211106232532992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (59064594011.*R.^30*S^2*Z^{28}*(S_{v3})^2)/ (13510798882111488*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24225.*R.^30.*R.*Z^2*S^2*Z^{28}*(S_{v3})^2)/ (140737488355328*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (4624109.*R.^31.*R.*Z*S^2*Z^{29}*(S_{v3})^2)/ (1688849860263936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (36553306561.*R.^32*S^2*Z^{30}*(S_{v3})^2)/ (40532396646334464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (323.*R.^32.*R.*Z^2*S^2*Z^{30}*(S_{v3})^2)/ (35184372088832*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (679915.*R.^33.*R.*Z*S^2*Z^{31}*(S_{v3})^2)/ (3377699720527872*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1189947216611.*R.^34*S^2*Z^{32}*(S_{v3})^2)/ (6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (27455.*R.^34.*R.*Z^2*S^2*Z^{32}*(S_{v3})^2)/ (72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108205.*R.^35.*R.*Z*S^2*Z^{33}*(S_{v3})^2)/ (9007199254740992*(1 + Z^{2/4} + Z^{4/64})^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (105030792781 \cdot R^{\wedge 36} S^{\wedge 2} Z^{\wedge 34} (S_{\wedge 3})^{\wedge 2}) / (3458764513820540928 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (855 \cdot R^{\wedge 36} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 34} (S_{\wedge 3})^{\wedge 2}) / (72057594037927936 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (990641 \cdot R^{\wedge 37} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 35} (S_{\wedge 3})^{\wedge 2}) / (1729382256910270464 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (548568674633 \cdot R^{\wedge 38} S^{\wedge 2} Z^{\wedge 36} (S_{\wedge 3})^{\wedge 2}) / \dots \\
& (110680464442257309696 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (1805 \cdot R^{\wedge 38} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 36} (S_{\wedge 3})^{\wedge 2}) / (6917529027641081856 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (294785 \cdot R^{\wedge 39} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 37} (S_{\wedge 3})^{\wedge 2}) / (13835058055282163712 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (10322387501 \cdot R^{\wedge 40} S^{\wedge 2} Z^{\wedge 38} (S_{\wedge 3})^{\wedge 2}) / \dots \\
& (13835058055282163712 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (25 \cdot R^{\wedge 40} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 38} (S_{\wedge 3})^{\wedge 2}) / (6917529027641081856 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (32965 \cdot R^{\wedge 41} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 39} (S_{\wedge 3})^{\wedge 2}) / (55340232221128654848 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (1462601471251 \cdot R^{\wedge 42} S^{\wedge 2} Z^{\wedge 40} (S_{\wedge 3})^{\wedge 2}) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (7 \cdot R^{\wedge 42} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 40} (S_{\wedge 3})^{\wedge 2}) / (295147905179352825856 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (15635 \cdot R^{\wedge 43} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 41} (S_{\wedge 3})^{\wedge 2}) / (1328165573307087716352 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (185335180013 \cdot R^{\wedge 44} S^{\wedge 2} Z^{\wedge 42} (S_{\wedge 3})^{\wedge 2}) / \dots \\
& (14167099448608935641088 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (3115 \cdot R^{\wedge 45} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 43} (S_{\wedge 3})^{\wedge 2}) / (21250649172913403461632 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (2057042720599 \cdot R^{\wedge 46} S^{\wedge 2} Z^{\wedge 44} (S_{\wedge 3})^{\wedge 2}) / (1360041547066457821544448 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) \\
& + \dots \\
& (49 \cdot R^{\wedge 47} \cdot R \cdot Z^{\wedge 2} S^{\wedge 2} Z^{\wedge 45} (S_{\wedge 3})^{\wedge 2}) / (56668397794435742564352 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (24026340573 \cdot R^{\wedge 48} S^{\wedge 2} Z^{\wedge 46} (S_{\wedge 3})^{\wedge 2}) / \dots \\
& (151115727451828646838272 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& (5273670271697 \cdot R^{\wedge 50} S^{\wedge 2} Z^{\wedge 48} (S_{\wedge 3})^{\wedge 2}) / (348170636049013202315378688 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (37823055319 \cdot R^{\wedge 52} S^{\wedge 2} Z^{\wedge 50} (S_{\wedge 3})^{\wedge 2}) / (29014219670751100192948224 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \\
& \dots \\
& (31266829573 \cdot R^{\wedge 54} S^{\wedge 2} Z^{\wedge 52} (S_{\wedge 3})^{\wedge 2}) / (309485009821345068724781056 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) \\
& + \dots \\
& (305764487 \cdot R^{\wedge 56} S^{\wedge 2} Z^{\wedge 54} (S_{\wedge 3})^{\wedge 2}) / (43521329506126650289422336 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (155671821505 \cdot R^{\wedge 58} S^{\wedge 2} Z^{\wedge 56} (S_{\wedge 3})^{\wedge 2}) / (356526731314189519170947776512 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (8605263625 \cdot R^{\wedge 60} S^{\wedge 2} Z^{\wedge 58} (S_{\wedge 3})^{\wedge 2}) / (356526731314189519170947776512 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (4487015167 \cdot R^{\wedge 62} S^{\wedge 2} Z^{\wedge 60} (S_{\wedge 3})^{\wedge 2}) / (3802951800684688204490109616128 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (64197131 \cdot R^{\wedge 64} S^{\wedge 2} Z^{\wedge 62} (S_{\wedge 3})^{\wedge 2}) / (1267650600228229401496703205376 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (7366421503 \cdot R^{\wedge 66} S^{\wedge 2} Z^{\wedge 64} (S_{\wedge 3})^{\wedge 2}) / (3894222643901120721397872246915072 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (118374655 \cdot R^{\wedge 68} S^{\wedge 2} Z^{\wedge 66} (S_{\wedge 3})^{\wedge 2}) / (1947111321950560360698936123457536 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (103217975 \cdot R^{\wedge 70} S^{\wedge 2} Z^{\wedge 68} (S_{\wedge 3})^{\wedge 2}) / (62307562302417931542365955950641152 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (1169089 \cdot R^{\wedge 72} S^{\wedge 2} Z^{\wedge 70} (S_{\wedge 3})^{\wedge 2}) / (31153781151208965771182977975320576 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (16453715 \cdot R^{\wedge 74} S^{\wedge 2} Z^{\wedge 72} (S_{\wedge 3})^{\wedge 2}) / (23926103924128485712268527085046202368 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (234365 \cdot R^{\wedge 76} S^{\wedge 2} Z^{\wedge 74} (S_{\wedge 3})^{\wedge 2}) / (23926103924128485712268527085046202368 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (77905 \cdot R^{\wedge 78} S^{\wedge 2} Z^{\wedge 76} (S_{\wedge 3})^{\wedge 2}) / (765635325572111542792592866721478475776 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (175 \cdot R^{\wedge 80} S^{\wedge 2} Z^{\wedge 78} (S_{\wedge 3})^{\wedge 2}) / (255211775190703847597530955573826158592 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4}) + \dots \\
& (49 \cdot R^{\wedge 82} S^{\wedge 2} Z^{\wedge 80} (S_{\wedge 3})^{\wedge 2}) / (21778071482940061661655974875633165533184 \cdot (1 + Z^{\wedge 2/4} + Z^{\wedge 4/64})^{\wedge 4});
\end{aligned}$$

$Ns3=Nf3+Nc+Nr3;$
 $\Phi3=Nf3./[Nc+Nr3];$
 $Be3=1./[1+\Phi3];$
 $Gf3=Nf3./Ns3;$
 $Gr3=[Nr3]./Ns3;$
 $Nh3=Nc+Nr3;$

$S_v4=12;$
 $Nf4=Br*[(Z^2)*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)];$
 $Nr4=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v4))/(384*(1 + Z^2/4 + Z^4/64)^2)+$
 $(R.^2.*R.*Z^2*S^2*(S_v4))/(4*(1 + Z^2/4 + Z^4/64)^2) - ...$
 $(43.*R.^4*S^2*Z^2*(S_v4))/(384*(1 + Z^2/4 + Z^4/64)^2)...$
 $+ (5.*R.^5.*R.*Z*S^2*Z^3*(S_v4))/(32*(1 + Z^2/4 + Z^4/64)^2)+$
 $(407.*R.^6*S^2*Z^4*(S_v4))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^7.*R.*Z*S^2*Z^5*(S_v4))/(768*(1 + Z^2/4 + Z^4/64)^2) +$
 $(539.*R.^8*S^2*Z^6*(S_v4))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(85225.*R.^10*S^2*Z^8*(S_v4))/(1572864*(1 + Z^2/4 + Z^4/64)^2) +$
 $(6487.*R.^12*S^2*Z^10*(S_v4))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(17773.*R.^14*S^2*Z^12*(S_v4))/(4194304*(1 + Z^2/4 + Z^4/64)^2) +$
 $(2011.*R.^16*S^2*Z^14*(S_v4))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(206775.*R.^18*S^2*Z^16*(S_v4))/(1073741824*(1 + Z^2/4 + Z^4/64)^2) +$
 $(108275.*R.^20*S^2*Z^18*(S_v4))/(3221225472*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(512435.*R.^22*S^2*Z^20*(S_v4))/(103079215104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(21031.*R.^24*S^2*Z^22*(S_v4))/(34359738368*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(272987.*R.^26*S^2*Z^24*(S_v4))/(4398046511104*(1 + Z^2/4 + Z^4/64)^2) +$
 $(11305.*R.^28*S^2*Z^26*(S_v4))/(219902325552*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(24225.*R.^30*S^2*Z^28*(S_v4))/(70368744177664*(1 + Z^2/4 + Z^4/64)^2) +$
 $(323.*R.^32*S^2*Z^30*(S_v4))/(17592186044416*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(27455.*R.^34*S^2*Z^32*(S_v4))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) +$
 $(855.*R.^36*S^2*Z^34*(S_v4))/(36028797018963968*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(1805.*R.^38*S^2*Z^36*(S_v4))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(25.*R.^40*S^2*Z^38*(S_v4))/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^2) + ...$
 $(7.*R.^42*S^2*Z^40*(S_v4))/(147573952589676412928*(1 + Z^2/4 + Z^4/64)^2) +$
 $(625.*R.^2*S^2*(S_v4)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(25.*R.^2.*R.*Z^2*S^2*(S_v4)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) +$
 $(R.^2.*R.*Z^4*S^2*(S_v4)^2)/(16*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(1075.*R.^4*S^2*Z^2*(S_v4)^2)/(73728*(1 + Z^2/4 + Z^4/64)^4) +$
 $(43.*R.^4.*R.*Z^2*S^2*Z^2*(S_v4)^2)/(768*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(125.*R.^5.*R.*Z*S^2*Z^3*(S_v4)^2)/(6144*(1 + Z^2/4 + Z^4/64)^4) +$
 $(5.*R.^5.*R.*Z^3*S^2*Z^3*(S_v4)^2)/(64*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(60109.*R.^6*S^2*Z^4*(S_v4)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(407.*R.^6.*R.*Z^2*S^2*Z^4*(S_v4)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(4985.*R.^7.*R.*Z*S^2*Z^5*(S_v4)^2)/(147456*(1 + Z^2/4 + Z^4/64)^4) +$
 $(7.*R.^7.*R.*Z^3*S^2*Z^5*(S_v4)^2)/(1536*(1 + Z^2/4 + Z^4/64)^4) - ...$
 $(671.*R.^8*S^2*Z^6*(S_v4)^2)/(131072*(1 + Z^2/4 + Z^4/64)^4) +$
 $(739.*R.^8.*R.*Z^2*S^2*Z^6*(S_v4)^2)/(8192*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(17111.*R.^9.*R.*Z*S^2*Z^7*(S_v4)^2)/(589824*(1 + Z^2/4 + Z^4/64)^4) -$
 $(3787661.*R.^10*S^2*Z^8*(S_v4)^2)/(301989888*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(31395.*R.^10.*R.*Z^2*S^2*Z^8*(S_v4)^2)/(1048576*(1 + Z^2/4 + Z^4/64)^4) +$
 $(67529.*R.^11.*R.*Z*S^2*Z^9*(S_v4)^2)/(1572864*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(1627151.*R.^12*S^2*Z^10*(S_v4)^2)/(100663296*(1 + Z^2/4 + Z^4/64)^4) +$
 $(19657.*R.^12.*R.*Z^2*S^2*Z^10*(S_v4)^2)/(2359296*(1 + Z^2/4 + Z^4/64)^4) + ...$
 $(486493.*R.^13.*R.*Z*S^2*Z^11*(S_v4)^2)/(25165824*(1 + Z^2/4 + Z^4/64)^4) +$
 $(241027273.*R.^14*S^2*Z^12*(S_v4)^2)/(9663676416*(1 + Z^2/4 + Z^4/64)^4) + ...$

$$\begin{aligned}
& (17773.*R.^{14}.*R.*Z^2*S^2*Z^{12}*(S_v4)^2)/(8388608*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3710335.*R.^{15}.*R.*Z*S^2*Z^{13}*(S_v4)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (53842355.*R.^{16}.*S^2*Z^{14}*(S_v4)^2)/(3221225472*(1 + Z^2/4 + Z^4/64)^4) + \\
& (2011.*R.^{16}.*R.*Z^2*S^2*Z^{14}*(S_v4)^2)/(4194304*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (981421.*R.^{17}.*R.*Z*S^2*Z^{15}*(S_v4)^2)/(603979776*(1 + Z^2/4 + Z^4/64)^4) + \\
& (19618549477.*R.^{18}.*S^2*Z^{16}*(S_v4)^2)/(2473901162496*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (206775.*R.^{18}.*R.*Z^2*S^2*Z^{16}*(S_v4)^2)/(2147483648*(1 + Z^2/4 + Z^4/64)^4) + \\
& (607051.*R.^{19}.*R.*Z*S^2*Z^{17}*(S_v4)^2)/(1610612736*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (944668661.*R.^{20}.*S^2*Z^{18}*(S_v4)^2)/(309237645312*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108275.*R.^{20}.*R.*Z^2*S^2*Z^{18}*(S_v4)^2)/(6442450944*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (4002553.*R.^{21}.*R.*Z*S^2*Z^{19}*(S_v4)^2)/(51539607552*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3348433219.*R.^{22}.*S^2*Z^{20}*(S_v4)^2)/(3298534883328*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (512435.*R.^{22}.*R.*Z^2*S^2*Z^{20}*(S_v4)^2)/(206158430208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5778425.*R.^{23}.*R.*Z*S^2*Z^{21}*(S_v4)^2)/(412316860416*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (1484626111.*R.^{24}.*S^2*Z^{22}*(S_v4)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (21031.*R.^{24}.*R.*Z^2*S^2*Z^{22}*(S_v4)^2)/(68719476736*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (10718225.*R.^{25}.*R.*Z*S^2*Z^{23}*(S_v4)^2)/(4947802324992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (33848465467.*R.^{26}.*S^2*Z^{24}*(S_v4)^2)/(422212465065984*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (272987.*R.^{26}.*R.*Z^2*S^2*Z^{24}*(S_v4)^2)/(8796093022208*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11158205.*R.^{27}.*R.*Z*S^2*Z^{25}*(S_v4)^2)/(39582418599936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (24750045961.*R.^{28}.*S^2*Z^{26}*(S_v4)^2)/(1266637395197952*(1 + Z^2/4 + Z^4/64)^4) + \\
& (11305.*R.^{28}.*R.*Z^2*S^2*Z^{26}*(S_v4)^2)/(4398046511104*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (6450277.*R.^{29}.*R.*Z*S^2*Z^{27}*(S_v4)^2)/(211106232532992*(1 + Z^2/4 + Z^4/64)^4) + \\
& (59064594011.*R.^{30}.*S^2*Z^{28}*(S_v4)^2)/(13510798882111488*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (24225.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v4)^2)/(140737488355328*(1 + Z^2/4 + Z^4/64)^4) + \\
& (4624109.*R.^{31}.*R.*Z*S^2*Z^{29}*(S_v4)^2)/(1688849860263936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (36553306561.*R.^{32}.*S^2*Z^{30}*(S_v4)^2)/(40532396646334464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (323.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v4)^2)/(35184372088832*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (679915.*R.^{33}.*R.*Z*S^2*Z^{31}*(S_v4)^2)/(3377699720527872*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1189947216611.*R.^{34}.*S^2*Z^{32}*(S_v4)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v4)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \\
& (108205.*R.^{35}.*R.*Z*S^2*Z^{33}*(S_v4)^2)/(9007199254740992*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (105030792781.*R.^{36}.*S^2*Z^{34}*(S_v4)^2)/(3458764513820540928*(1 + Z^2/4 + Z^4/64)^4) + \\
& (855.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v4)^2)/(72057594037927936*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (990641.*R.^{37}.*R.*Z*S^2*Z^{35}*(S_v4)^2)/(1729382256910270464*(1 + Z^2/4 + Z^4/64)^4) + \\
& (548568674633.*R.^{38}.*S^2*Z^{36}*(S_v4)^2)/... \\
& (110680464442257309696*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v4)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (294785.*R.^{39}.*R.*Z*S^2*Z^{37}*(S_v4)^2)/(13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (10322387501.*R.^{40}.*S^2*Z^{38}*(S_v4)^2)/... \\
& (13835058055282163712*(1 + Z^2/4 + Z^4/64)^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v4)^2)/(6917529027641081856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (32965.*R.^{41}.*R.*Z*S^2*Z^{39}*(S_v4)^2)/(55340232221128654848*(1 + Z^2/4 + Z^4/64)^4) + \\
& (1462601471251.*R.^{42}.*S^2*Z^{40}*(S_v4)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v4)^2)/(295147905179352825856*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v4)^2)/(1328165573307087716352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (185335180013.*R.^{44}.*S^2*Z^{42}*(S_v4)^2)/... \\
& (14167099448608935641088*(1 + Z^2/4 + Z^4/64)^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^{43}*(S_v4)^2)/(21250649172913403461632*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (2057042720599.*R.^{46}.*S^2*Z^{44}*(S_v4)^2)/(1360041547066457821544448*(1 + Z^2/4 + Z^4/64)^4) + \\
& + \dots \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v4)^2)/(56668397794435742564352*(1 + Z^2/4 + Z^4/64)^4) + \\
& (24026340573.*R.^{48}.*S^2*Z^{46}*(S_v4)^2)/...
\end{aligned}$$

$$\begin{aligned}
& (151115727451828646838272*(1 + Z^2/4 + Z^4/64)^4) + \\
& (5273670271697.*R.^50*S^2*Z^48*(S_v4)^2)/(348170636049013202315378688*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (37823055319.*R.^52*S^2*Z^50*(S_v4)^2)/(29014219670751100192948224*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (31266829573.*R.^54*S^2*Z^52*(S_v4)^2)/(309485009821345068724781056*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (305764487.*R.^56*S^2*Z^54*(S_v4)^2)/(43521329506126650289422336*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (155671821505.*R.^58*S^2*Z^56*(S_v4)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (8605263625.*R.^60*S^2*Z^58*(S_v4)^2)/(356526731314189519170947776512*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (4487015167.*R.^62*S^2*Z^60*(S_v4)^2)/(3802951800684688204490109616128*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (64197131.*R.^64*S^2*Z^62*(S_v4)^2)/(1267650600228229401496703205376*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (7366421503.*R.^66*S^2*Z^64*(S_v4)^2)/(3894222643901120721397872246915072*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (118374655.*R.^68*S^2*Z^66*(S_v4)^2)/(1947111321950560360698936123457536*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (103217975.*R.^70*S^2*Z^68*(S_v4)^2)/(62307562302417931542365955950641152*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (1169089.*R.^72*S^2*Z^70*(S_v4)^2)/(31153781151208965771182977975320576*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (16453715.*R.^74*S^2*Z^72*(S_v4)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (234365.*R.^76*S^2*Z^74*(S_v4)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (77905.*R.^78*S^2*Z^76*(S_v4)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (175.*R.^80*S^2*Z^78*(S_v4)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 + Z^4/64)^4) + \dots \\
& (49.*R.^82*S^2*Z^80*(S_v4)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 + Z^4/64)^4);
\end{aligned}$$

$$\begin{aligned}
& Ns4=Nf4+Nc+Nr4; \\
& Phi4=Nf4./[Nc+Nr4]; \\
& Be4=1./[1+Phi4]; \\
& Gf4=Nf4./Ns4; \\
& Gr4=[Nr4]./Ns4; \\
& Nh4=Nc+Nr4;
\end{aligned}$$

$$\begin{aligned}
& S_v5=16; \\
& Nf5=Br*[(Z^2).*exp(-2.*R.*Z)+(Z^2)*exp(-2*Z)-2*Z^2.*exp(-Z-R.*Z)]; \\
& Nr5=(R.^2*S^2)/4 + (25.*R.^2*S^2*(S_v5))/(384*(1 + Z^2/4 + Z^4/64)^2)+ \\
& (R.^2.*R.*Z^2*S^2*(S_v5))/(4*(1 + Z^2/4 + Z^4/64)^2) -... \\
& (43.*R.^4*S^2*Z^2*(S_v5))/(384*(1 + Z^2/4 + Z^4/64)^2)... \\
& + (5.*R.^5.*R.*Z*S^2*Z^3*(S_v5))/(32*(1 + Z^2/4 + Z^4/64)^2)+ \\
& (407.*R.^6*S^2*Z^4*(S_v5))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (7.*R.^7.*R.*Z*S^2*Z^5*(S_v5))/(768*(1 + Z^2/4 + Z^4/64)^2) + \\
& (539.*R.^8*S^2*Z^6*(S_v5))/(4096*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (85225.*R.^10*S^2*Z^8*(S_v5))/(1572864*(1 + Z^2/4 + Z^4/64)^2) + \\
& (6487.*R.^12*S^2*Z^10*(S_v5))/(393216*(1 + Z^2/4 + Z^4/64)^2) + ... \\
& (17773.*R.^14*S^2*Z^12*(S_v5))/(4194304*(1 + Z^2/4 + Z^4/64)^2) + \\
& (2011.*R.^16*S^2*Z^14*(S_v5))/(2097152*(1 + Z^2/4 + Z^4/64)^2) + ...
\end{aligned}$$

$$\begin{aligned}
& (206775.*R.^{18}*S^2*Z^{16}*(S_{v5}))/((1073741824*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (108275.*R.^{20}*S^2*Z^{18}*(S_{v5}))/((3221225472*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (512435.*R.^{22}*S^2*Z^{20}*(S_{v5}))/((103079215104*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (21031.*R.^{24}*S^2*Z^{22}*(S_{v5}))/((34359738368*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (272987.*R.^{26}*S^2*Z^{24}*(S_{v5}))/((4398046511104*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (11305.*R.^{28}*S^2*Z^{26}*(S_{v5}))/((2199023255552*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (24225.*R.^{30}*S^2*Z^{28}*(S_{v5}))/((70368744177664*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (323.*R.^{32}*S^2*Z^{30}*(S_{v5}))/((17592186044416*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (27455.*R.^{34}*S^2*Z^{32}*(S_{v5}))/((36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (855.*R.^{36}*S^2*Z^{34}*(S_{v5}))/((36028797018963968*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (1805.*R.^{38}*S^2*Z^{36}*(S_{v5}))/((3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (25.*R.^{40}*S^2*Z^{38}*(S_{v5}))/((3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^2) + ... \\
& (7.*R.^{42}*S^2*Z^{40}*(S_{v5}))/((147573952589676412928*(1 + Z^{2/4} + Z^{4/64})^2) + \\
& (625.*R.^{2}*S^2*(S_{v5})^2)/(147456*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (25.*R.^{2}*R.*Z^2*S^2*(S_{v5})^2)/(768*(1 + Z^{2/4} + Z^{4/64})^4) + Z^{4/64})^4) + \\
& (R.^{2}*R.*Z^4*S^2*(S_{v5})^2)/(16*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (1075.*R.^{4}*S^2*Z^2*(S_{v5})^2)/(73728*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (43.*R.^{4}*R.*Z^2*S^2*Z^2*(S_{v5})^2)/(768*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (125.*R.^{5}*R.*Z*S^2*Z^3*(S_{v5})^2)/(6144*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5.*R.^{5}*R.*Z^3*S^2*Z^3*(S_{v5})^2)/(64*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (60109.*R.^{6}*S^2*Z^4*(S_{v5})^2)/(2359296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (407.*R.^{6}*R.*Z^2*S^2*Z^4*(S_{v5})^2)/(8192*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (4985.*R.^{7}*R.*Z*S^2*Z^5*(S_{v5})^2)/(147456*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^{7}*R.*Z^3*S^2*Z^5*(S_{v5})^2)/(1536*(1 + Z^{2/4} + Z^{4/64})^4) - ... \\
& (671.*R.^{8}*S^2*Z^6*(S_{v5})^2)/(131072*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (739.*R.^{8}*R.*Z^2*S^2*Z^6*(S_{v5})^2)/(8192*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17111.*R.^{9}*R.*Z*S^2*Z^7*(S_{v5})^2)/(589824*(1 + Z^{2/4} + Z^{4/64})^4) - \\
& (3787661.*R.^{10}*S^2*Z^8*(S_{v5})^2)/(301989888*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (31395.*R.^{10}*R.*Z^2*S^2*Z^8*(S_{v5})^2)/(1048576*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (67529.*R.^{11}*R.*Z*S^2*Z^9*(S_{v5})^2)/(1572864*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1627151.*R.^{12}*S^2*Z^{10}*(S_{v5})^2)/(100663296*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19657.*R.^{12}*R.*Z^2*S^2*Z^{10}*(S_{v5})^2)/(2359296*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (486493.*R.^{13}*R.*Z*S^2*Z^{11}*(S_{v5})^2)/(25165824*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (241027273.*R.^{14}*S^2*Z^{12}*(S_{v5})^2)/(9663676416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (17773.*R.^{14}*R.*Z^2*S^2*Z^{12}*(S_{v5})^2)/(8388608*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3710335.*R.^{15}*R.*Z*S^2*Z^{13}*(S_{v5})^2)/(603979776*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (53842355.*R.^{16}*S^2*Z^{14}*(S_{v5})^2)/(3221225472*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (2011.*R.^{16}*R.*Z^2*S^2*Z^{14}*(S_{v5})^2)/(4194304*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (981421.*R.^{17}*R.*Z*S^2*Z^{15}*(S_{v5})^2)/(603979776*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (19618549477.*R.^{18}*S^2*Z^{16}*(S_{v5})^2)/(2473901162496*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (206775.*R.^{18}*R.*Z^2*S^2*Z^{16}*(S_{v5})^2)/(2147483648*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (607051.*R.^{19}*R.*Z*S^2*Z^{17}*(S_{v5})^2)/(1610612736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (944668661.*R.^{20}*S^2*Z^{18}*(S_{v5})^2)/(309237645312*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108275.*R.^{20}*R.*Z^2*S^2*Z^{18}*(S_{v5})^2)/(6442450944*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (4002553.*R.^{21}*R.*Z*S^2*Z^{19}*(S_{v5})^2)/(51539607552*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3348433219.*R.^{22}*S^2*Z^{20}*(S_{v5})^2)/(3298534883328*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (512435.*R.^{22}*R.*Z^2*S^2*Z^{20}*(S_{v5})^2)/(206158430208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5778425.*R.^{23}*R.*Z*S^2*Z^{21}*(S_{v5})^2)/(412316860416*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (1484626111.*R.^{24}*S^2*Z^{22}*(S_{v5})^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (21031.*R.^{24}*R.*Z^2*S^2*Z^{22}*(S_{v5})^2)/(68719476736*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (10718225.*R.^{25}*R.*Z*S^2*Z^{23}*(S_{v5})^2)/(4947802324992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (33848465467.*R.^{26}*S^2*Z^{24}*(S_{v5})^2)/(422212465065984*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (272987.*R.^{26}*R.*Z^2*S^2*Z^{24}*(S_{v5})^2)/(8796093022208*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11158205.*R.^{27}*R.*Z*S^2*Z^{25}*(S_{v5})^2)/(39582418599936*(1 + Z^{2/4} + Z^{4/64})^4) + ... \\
& (24750045961.*R.^{28}*S^2*Z^{26}*(S_{v5})^2)/(1266637395197952*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (11305.*R.^{28}*R.*Z^2*S^2*Z^{26}*(S_{v5})^2)/(4398046511104*(1 + Z^{2/4} + Z^{4/64})^4) + ...
\end{aligned}$$

$$\begin{aligned}
& (6450277.*R.^{29}.*R.*Z*S^2*Z^{27}*(S_v5)^2)/(211106232532992*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (59064594011.*R.^{30}.*S^2*Z^{28}*(S_v5)^2)/(13510798882111488*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (24225.*R.^{30}.*R.*Z^2*S^2*Z^{28}*(S_v5)^2)/(140737488355328*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (4624109.*R.^{31}.*R.*Z*S^2*Z^{29}*(S_v5)^2)/(1688849860263936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (36553306561.*R.^{32}.*S^2*Z^{30}*(S_v5)^2)/(40532396646334464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (323.*R.^{32}.*R.*Z^2*S^2*Z^{30}*(S_v5)^2)/(35184372088832*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (679915.*R.^{33}.*R.*Z*S^2*Z^{31}*(S_v5)^2)/(3377699720527872*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1189947216611.*R.^{34}.*S^2*Z^{32}*(S_v5)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (27455.*R.^{34}.*R.*Z^2*S^2*Z^{32}*(S_v5)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (108205.*R.^{35}.*R.*Z*S^2*Z^{33}*(S_v5)^2)/(9007199254740992*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (105030792781.*R.^{36}.*S^2*Z^{34}*(S_v5)^2)/(3458764513820540928*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (855.*R.^{36}.*R.*Z^2*S^2*Z^{34}*(S_v5)^2)/(72057594037927936*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (990641.*R.^{37}.*R.*Z*S^2*Z^{35}*(S_v5)^2)/(1729382256910270464*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (548568674633.*R.^{38}.*S^2*Z^{36}*(S_v5)^2)/... \\
& (110680464442257309696*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1805.*R.^{38}.*R.*Z^2*S^2*Z^{36}*(S_v5)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (294785.*R.^{39}.*R.*Z*S^2*Z^{37}*(S_v5)^2)/(13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (10322387501.*R.^{40}.*S^2*Z^{38}*(S_v5)^2)/... \\
& (13835058055282163712*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (25.*R.^{40}.*R.*Z^2*S^2*Z^{38}*(S_v5)^2)/(6917529027641081856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (32965.*R.^{41}.*R.*Z*S^2*Z^{39}*(S_v5)^2)/(55340232221128654848*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (1462601471251.*R.^{42}.*S^2*Z^{40}*(S_v5)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (7.*R.^{42}.*R.*Z^2*S^2*Z^{40}*(S_v5)^2)/(295147905179352825856*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (15635.*R.^{43}.*R.*Z*S^2*Z^{41}*(S_v5)^2)/(1328165573307087716352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (185335180013.*R.^{44}.*S^2*Z^{42}*(S_v5)^2)/... \\
& (14167099448608935641088*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (3115.*R.^{45}.*R.*Z*S^2*Z^{43}*(S_v5)^2)/(21250649172913403461632*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (2057042720599.*R.^{46}.*S^2*Z^{44}*(S_v5)^2)/(1360041547066457821544448*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + \dots \\
& (49.*R.^{47}.*R.*Z*S^2*Z^{45}*(S_v5)^2)/(56668397794435742564352*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (24026340573.*R.^{48}.*S^2*Z^{46}*(S_v5)^2)/... \\
& (151115727451828646838272*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& (5273670271697.*R.^{50}.*S^2*Z^{48}*(S_v5)^2)/(348170636049013202315378688*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (37823055319.*R.^{52}.*S^2*Z^{50}*(S_v5)^2)/(29014219670751100192948224*(1 + Z^{2/4} + Z^{4/64})^4) + \\
& \dots \\
& (31266829573.*R.^{54}.*S^2*Z^{52}*(S_v5)^2)/(309485009821345068724781056*(1 + Z^{2/4} + Z^{4/64})^4) \\
& + \dots \\
& (305764487.*R.^{56}.*S^2*Z^{54}*(S_v5)^2)/(43521329506126650289422336*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (155671821505.*R.^{58}.*S^2*Z^{56}*(S_v5)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (8605263625.*R.^{60}.*S^2*Z^{58}*(S_v5)^2)/(356526731314189519170947776512*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (4487015167.*R.^{62}.*S^2*Z^{60}*(S_v5)^2)/(3802951800684688204490109616128*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (64197131.*R.^{64}.*S^2*Z^{62}*(S_v5)^2)/(1267650600228229401496703205376*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (7366421503.*R.^{66}.*S^2*Z^{64}*(S_v5)^2)/(3894222643901120721397872246915072*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (118374655.*R.^{68}.*S^2*Z^{66}*(S_v5)^2)/(1947111321950560360698936123457536*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (103217975.*R.^{70}.*S^2*Z^{68}*(S_v5)^2)/(62307562302417931542365955950641152*(1 + Z^{2/4} + Z^{4/64})^4) + \dots \\
& (1169089.*R.^{72}.*S^2*Z^{70}*(S_v5)^2)/(31153781151208965771182977975320576*(1 + Z^{2/4} + Z^{4/64})^4) + \dots
\end{aligned}$$

```

(16453715.*R.^74*S^2*Z^72*(S_v5)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 +
Z^4/64)^4) + ...
(234365.*R.^76*S^2*Z^74*(S_v5)^2)/(23926103924128485712268527085046202368*(1 + Z^2/4 +
Z^4/64)^4) + ...
(77905.*R.^78*S^2*Z^76*(S_v5)^2)/(765635325572111542792592866721478475776*(1 + Z^2/4 +
Z^4/64)^4) + ...
(175.*R.^80*S^2*Z^78*(S_v5)^2)/(255211775190703847597530955573826158592*(1 + Z^2/4 +
Z^4/64)^4) + ...
(49.*R.^82*S^2*Z^80*(S_v5)^2)/(21778071482940061661655974875633165533184*(1 + Z^2/4 +
Z^4/64)^4);

```

```

Ns5=Nf5+Nc+Nr5;
Phi5=Nf5./[Nc+Nr5];
Be5=1./[1+Phi5];
Gf5=Nf5./Ns5;
Gr5=[Nr5]./Ns5;
Nh5=Nc+Nr5;

```

```

plot(R,Ns1,'b',R,Ns2,'g',R,Ns3,'r',R,Ns4,'k',R,Ns5,'m')

% plot(R,Be1,'b',R,Be2,'g',R,Be3,'r',R,Be4,'k',R,Be5,'m')

% plot(R,Phi1,'b',R,Phi2,'g',R,Phi3,'r',R,Phi4,'k',R,Phi5,'m')

% plot(R,Gf1,'b',R,Gf2,'g',R,Gf3,'r',R,Gf4,'k',R,Gf5,'m')

% plot(R,Gr1,'b',R,Gr2,'g',R,Gr3,'r',R,Gr4,'k',R,Gr5,'m')

% plot(R,Nf1,'b',R,Nf2,'g',R,Nf3,'r',R,Nf4,'k',R,Nf5,'m')

% plot(R,Nh1,'b',R,Nh2,'g',R,Nh3,'r',R,Nh4,'k',R,Nh5,'m')

```

PLOTTOOLS ON